ALBERTA TRANSPORTATION SPRINGBANK OFF-STREAM RESERVOIR PROJECT
Response to NRCB and AEP Supplemental Information Request 2, dated November 18, 2019

Prepared for:
Alberta Transportation

Prepared by:
Stantec Consulting Ltd.

April 2020

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Acronyms

The following acronyms are used in this Supplemental Information Request.

asl	above sea level
AAAQO	Alberta Ambient Air Quality Objective
AEP	Alberta Environment and Parks
ACIS	Alberta Collision Information System
AVCPL	animal-vehicle collision prone locations
AWW	Alberta Wildlife Watch
BOD	biochemical oxygen demand
CEAA	Canadian Environmental Assessment Agency
COPC	chemicals of potential concern
DFO	Fisheries and Oceans Canada
DO	dissolved oxygen
ECCC	Environment Climate Change Canada
ECO Plan	Environmental Construction Operations Plan
EIA	environmental impact assessment
ENFOR	Enforcement Occurrence Record
ER	exposure ratio
GOA	Government of Alberta
ha	hectare
HHRA	human health risk assessment
IR	information request
KDE+	Kernel Density Estimate
km	kilometre
KWBZ	key wildlife and biodiversity zone
LAA	local assessment area
m	metre
mm	millimetre
m/s	metres per second
NRCB	Natural Resources Conservation Board

PDA	Project development area
$PM_{2.5}$	particulate matter less than 2.5 micrometers in diameter
POI	points of interest
RAA	regional assessment area
RBF	radial basis function
RFDAM	Rapid Flood Damage Assessment Model
TDR	technical data report
TRV	toxicological reference value
TSP	total suspended particles
TSS	total suspended solids
U.S. EPA	United States Environmental Protection Agency
WMMP	Wildlife Mitigation and Monitoring Plan
ZOI	zone of influence
ZREC	reclaimed land

1 NATURAL RESOURCES CONSERVATION BOARD

Question 1

CEAA letter to AT, July 16, 2019, Overarching issues, 5, Page 2

CEAA states *while data from submissions from engagement with Indigenous groups is presented as discrete pieces of information, the analysis of this information requested by the Agency is not included in the response….[T]he Agency requested that Alberta Transportation present the input obtained from Indigenous groups, including a description of how that input was integrated into the responses for all information request items relating to effects of changes to the environment on Indigenous peoples (CEAA 2012 section 5(1)(c)) and potential impacts to Aboriginal and treaty rights. Additionally, the Agency indicated that points of disagreement between the views of Alberta Transportation and Indigenous groups should be presented, along with a description of efforts undertaken to reconcile these differences and a rationale for conclusions.*

a. **Provide the information obtained from Indigenous groups. Include a description of the environmental effects of the project on Indigenous peoples and the potential impacts to Aboriginal and treaty rights.**

b. **Provide details on points of disagreement on potential issues between Alberta Transportation and Indigenous groups, including descriptions of efforts undertaken to reconcile these differences and the rationale for the conclusions made.**

Response

This response was included in the April 8, 2020 filing.

Question 2

Supplemental Information Request 1, Question 14, Pages 2.22-2.23
Supplemental Information Request 1, Question 15, Page 2.24

Alberta Transportation states that the *Interim Design Report is still in draft as engineering investigation and designs are in the process of being advanced; therefore, it is not being provided. The finalized design report will be made available once complete.*

a. **Provide the stamped, signed version of the report titled "Springbank Off-Stream Storage Project Interim Design Report" (Stantec Consulting Ltd. 2017b.).**

Response

This response will be included in a future filing.

Question 3

Supplemental Information Request 1, Question 30, Pages 2.48-2.49
Supplemental Information Request 1, Appendix IR6-1, Page 5

Alberta Transportation states that *The utility of using a benefit/cost analysis to compare SR1 to the preliminary cost estimates for the MC1 Option is questionable. Not only do they continue to diverge in terms of the detail and confidence in cost estimates, but challenges arise in attempting to align the two projects for a fair benefit/cost comparison.*

As described in Appendix IR6-1, it is unrealistic to align SR1 and the MC1 Option with a common start year because there are five years of costs to date for SR1, and the costs include environmental assessment costs and the regulatory review process.

a. **Describe the weight placed on the benefit/cost analysis for MC1/SR1 in selecting SR1 (or rejecting MC1). If the benefit/cost analysis was not used in the site selection criteria explain why.**

b. **Comment on whether the updated benefit/cost analysis conducted in 2019 changes Alberta Transportation's assessment of site selection between SR1 and MC1 from a benefit cost perspective.**

c. **Provide the five reports listed in the page 5 footnotes of Appendix IR6-1.**

Response

This response will be included in a future filing.

Question 4

Volume 4, Appendix E, Attachment 3A Section 3A.3.3, Equation 3A.7, Page 3A.32
Section 3A.3.4, Equation 3A.10, Page 3A.39
Section 3A.3.6, Equation 3A.16, Page 3A.57
Volume 4, Appendix G, TDR, Attachment C, C.4, Table C-17, Pages C.67 to C.69
Supplemental Information Request 1, Question 16, Table IR16-2, Page 2.28

Soil silt content used in calculating emission rates are 6.9% to 8.5%, which are based on referenced numbers (Appendix E), while silt content of soils at the project site range from 14% to 66% (Appendix G, Table C-17).

a. **Recalculate emission factors in equations 3A.7, 3A.10 and 3A.16 using the silt content of soil at the project site.**

b. **Update Table IR16-2, with the recalculated emission factors and any other related emission rate assessments in the EIA.**

Response

a. The Terrain and Soils Technical Data Report (environmental impact assessment [EIA], Volume 4, Appendix G) describes the methods and presents the results of the detailed soil survey and soils mapping of the local assessment area (LAA). The soil samples analyzed for silt content (Appendix G, Table C-17) were collected to a depth of approximately 1.0 m below ground surface, which is limited to the topsoil and subsoil layers based on the measured topsoil and subsoil depths (Appendix G, Table 3-22, Figure 3-7 and Figure 3-8). The average measured topsoil depth in the Project development area (PDA) is 20 cm to 40 cm (Appendix G, Table 3-22 and Figure 3-7) and the average measured subsoil depth in the PDA is 10 cm to 30 cm (Appendix G, Table 3-22 and Figure 3-8). The analyzed soil profiles in Appendix G, which indicate higher silt content, are representative exclusively of the topsoil and subsoil layers and not of the underlying overburden and bedrock.

   Topsoil from the diversion channel, off-stream dam and floodplain berm will be stripped and stored at a temporary topsoil stockpile northwest of the diversion structure, thus exposing overburden at most construction areas. The excavated material from the diversion channel and borrow area will be used for the construction of the off-stream dam. The primary haul road for construction of the off-stream dam will be along the excavated diversion channel and will be comprised of aggregate material on top of overburden and bedrock.

   The silt content for the overburden material has not been analyzed and the design and specifications of the aggregate material that will be used for the haul roads are unknown at this time. Therefore, the fugitive dust emission factors (Volume 4, Appendix E, Attachment 3A) are calculated using typical or average mean silt content values for construction haul roads published by the United States Environmental Protection Agency (U.S. EPA) (8.5%, Table 13.2.2-1 in U.S. EPA 2006) and overburden (6.9%, Table 11.9-3 in U.S. EPA 1998).

   The fugitive dust emission factors for truck traffic on haul roads, off-road equipment in transition, and bulldozing and grading (Volume 4, Appendix E, Attachment 3A, Equations 3A.7, 3A.10 and 3A.16) do not need to be recalculated using the measured silt content of soils (Appendix G, Table C-17). The silt content values in Appendix G are representative of top and subsoil and not the underlying overburden and bedrock. In the absence of Project-specific measurements, the U.S. EPA recommended average silt content values (6.9% to 8.5%) are considered representative of the Project.

   During construction, adaptive management techniques will be used to help control the generation of airborne dust (see Volume 3A, Section 3.4.4.1 and Volume 3C, Section 2.2). Ambient air monitoring of particulate matter less than 2.5 micrometers in diameter ($PM_{2.5}$) and total suspended particles (TSP) concentrations will be used to assess the need for more rigorous dust mitigation. If the monitoring program indicates that the ground-level $PM_{2.5}$ and TSP concentrations are greater than Alberta ambient air quality objectives (AAAQO) (AEP 2019), additional mitigation to reduce dust emissions and maintain acceptable air quality will be implemented. The mitigation may include suspension of dust generating construction activities during periods of excessive winds, application of water to haul roads and silt fences and other erosion control methods such as mulching to prevent soil loss from stockpiles due to wind erosion.

b. Based upon the response provided in the response to a., Table IR16-2 does not require updating.

REFERENCES

AEP (Alberta Environment and Parks). 2019. Alberta Ambient Air Quality Objectives and Guidelines Summary. January 2019. Alberta Environment and Parks (AEP). Available at: https://open.alberta.ca/dataset/0d2ad470-117e-410f-ba4f-aa352cb02d4d/resource/4ddd8097-6787-43f3-bb4a-908e20f5e8f1/download/aaqo-summary-jan2019.pdf. Accessed: January 2020.

U.S. EPA (United States Environmental Protection Agency). 1998. AP-42, Fifth Edition Compilation of Air Pollutant Emission Factors. Volume 1, Chapter 11, Section 9. Western Surface Coal Mining. October 1998. United States Environmental Protection Agency (U.S. EPA). Available at: https://www3.epa.gov/ttn/chief/ap42/ch11/final/c11s09.pdf. Accessed: January 2020.

U.S. EPA. 2006. AP-42, Fifth Edition Compilation of Air Pollutant Emission Factors. Volume 1, Chapter 13, Section 2.2. Unpaved Roads. November 2006. United States Environmental Protection Agency (U.S. EPA). Available at: https://www3.epa.gov/ttn/chief/ap42/ch13/final/c13s0202.pdf. Accessed: January 2020.

Question 5

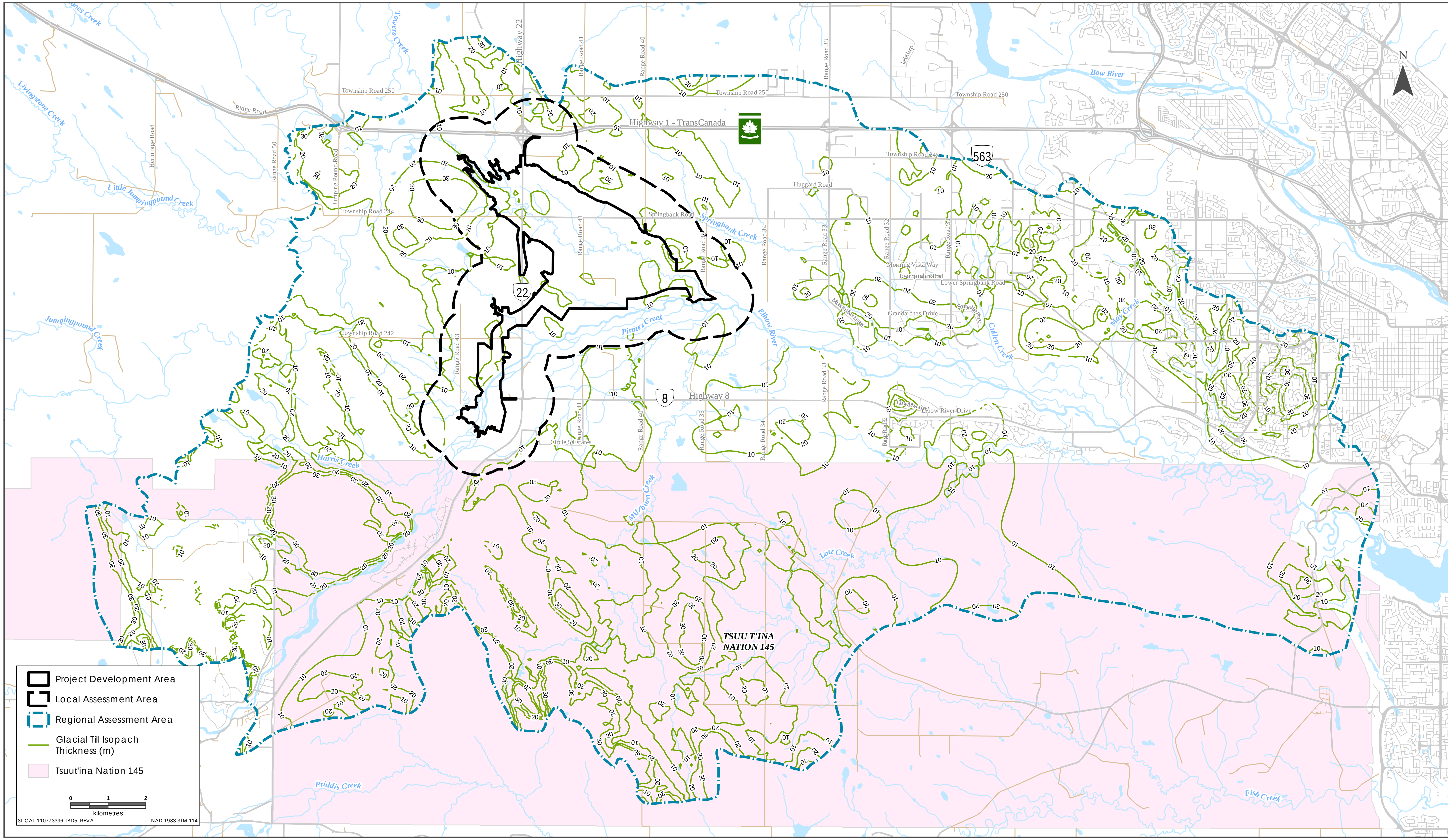
Supplemental Information Request 1, Question 42, Page 2.66
Supplemental Information Request 1, Appendix IR42-1, Figures 3-8, 3-10, and 3-12, Pages 3.15, 3.19, and 3.23

Figures 3-8, 3-10 and 3-12 in Appendix IR42-1 show isopach maps for glacial till, glaciolacustrine, and recent fluvial deposits. Contour labels are not shown for all areas in the expanded RAA and it is not obvious what they are.

a. Provide the missing labels for the isopach contours in the expanded RAA.

Response

a. The contour labels in Alberta Transportation's response to Round 1 Natural Resources Conservation Board (NRCB) information request (IR)42-1, Appendix IR42-1, Figures 3-8, 3-10 and 3-12 have been revised in the following figures: Figure 5-1, Figure 5-2, and Figure 5-3.



Sources: Base Data - Government of Alberta, Government of Canada. Thematic Data - Stantec Ltd.

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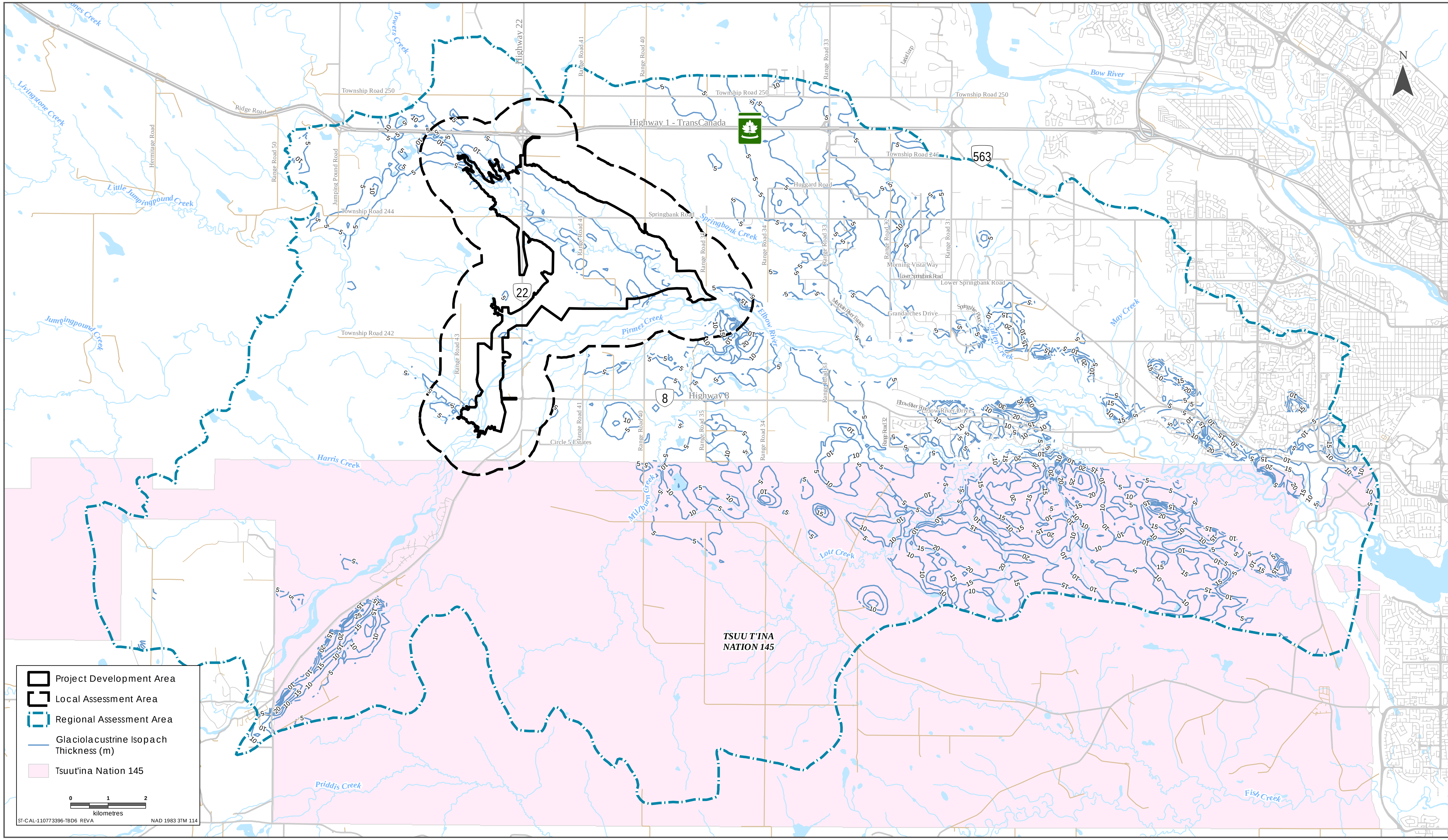
ALBERTA TRANSPORTATION SPRINGBANK OFF-STREAM RESERVOIR PROJECT ENVIRONMENTAL IMPACT ASSESSMENT

Isopach Map of the Glacial Till

Figure 5-1



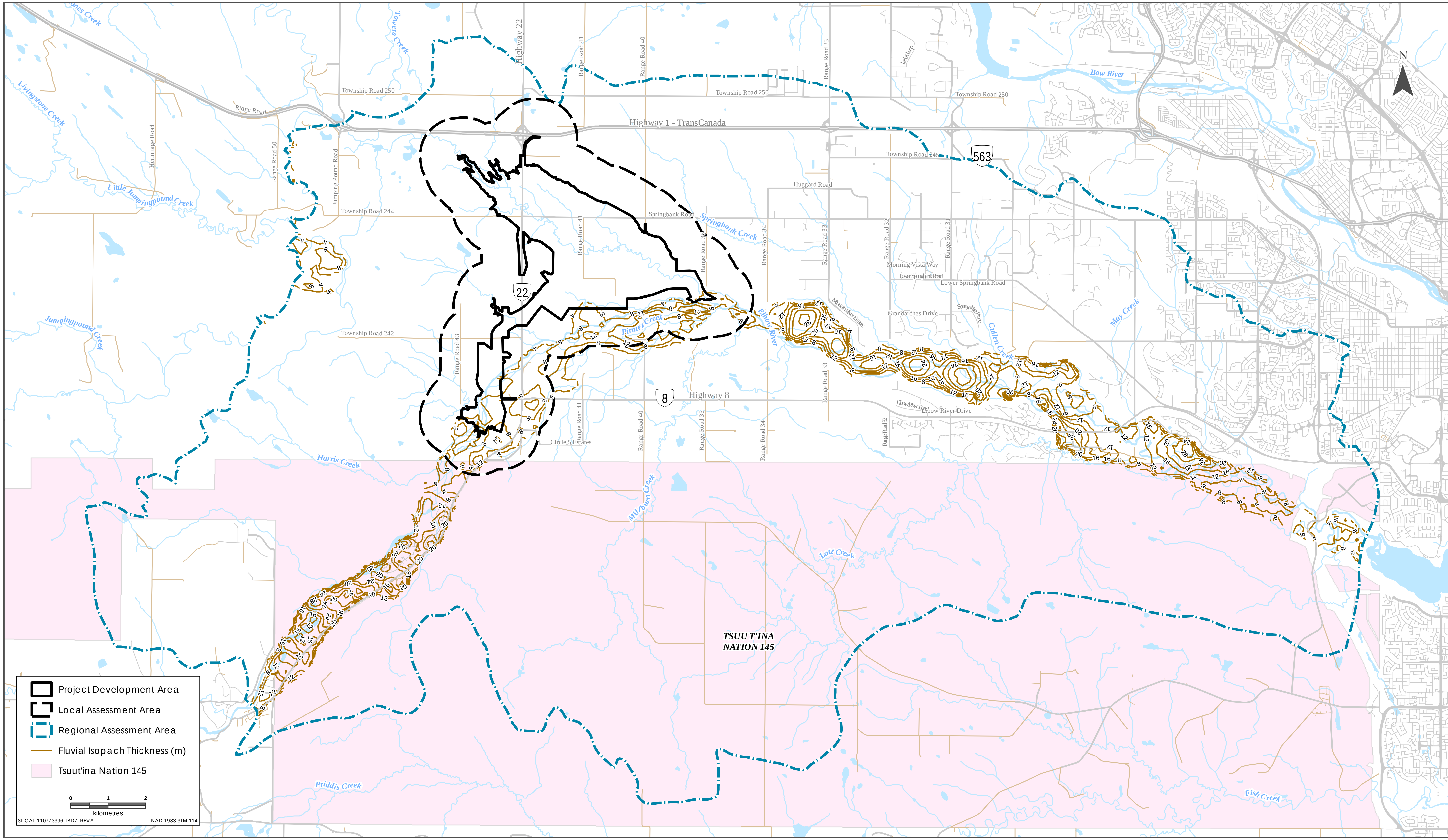
Sources: Base Data - Government of Alberta, Government of Canada. Thematic Data - Stantec Ltd.

Stantec

ALBERTA TRANSPORTATION SPRINGBANK OFF-STREAM RESERVOIR PROJECT ENVIRONMENTAL IMPACT ASSESSMENT

Isopach Map of the Glaciolacustrine Deposits

Figure 5-2



Sources: Base Data - Government of Alberta, Government of Canada. Thematic Data - Stantec Ltd.

Isopach Map of the Recent Fluvial Deposits

Figure 5-3

Question 6

Supplemental Information Request 1, Question 42, Page 2.66
Supplemental Information Request 1, Appendix IR42-1, Figures 3-4 to 3-12, Pages 3.6 to 3.23, and Figures 4-5 to 4-11, Pages 4.9 to 4.12.

Alberta Transportation used a mathematical model to depict the subsurface geologic setting and associated physical parameters that govern the flow of groundwater through porous media. Alberta Transportation states *the effects of fractures are not implemented explicitly using a numerical solution, [but] the numerical model accounts for increased permeability due to the bedrock fractures by including a higher hydraulic conductivity layer.*

Appendix IR42-1, Figures 4-5 to 4-11, depict spatially variable hydraulic conductivities that were assigned to the model layers, depending on the geologic materials represented in that layer.

a. Provide justification for the one order of magnitude difference in hydraulic conductivities between the upper portion of the fractured bedrock and the lower bedrock, as no monitoring wells were completed within the fractured bedrock.

Response

a. The question states that "no monitoring wells were completed within the fractured bedrock." This statement is incorrect. Five monitoring wells were completed within the upper fractured and weathered bedrock. These monitoring wells are MW16-1-15; MW16-5-11; MW16-18-10; MW16-21-11; and MW16-26-18. Borehole logs are included in the Hydrogeology Technical Data Report Update (TDR Update) (see Alberta Transportation's response to Round 1 AEP IR42, Appendix IR42-1), Attachment A.

   A total of 44 hydraulic conductivity tests were completed, including seven single-well response tests and 37 single packer permeability tests, to evaluate the hydraulic properties of the bedrock material. The results of the single-well response tests and packer permeability tests are presented in the TDR Update, Table 3-1 and Table 3-2. The hydraulic conductivity estimates, in conjunction with drilling observations and regional information, provide justification for the order of magnitude difference between the upper and lower bedrock.

Question 7

Supplemental Information Request 1, Question 42, Page 2.66
Supplemental Information Request 1, Appendix IR42-1, Figures 3-24, 3-25, and 3-26, Pages 3.50 to 3.52, and Table 2-1, Page 2.7

Alberta Transportation provides hydrographs of monitoring wells that were completed in unconsolidated deposits and bedrock in Figures 3-24, 3-25 and 3-26. There are inconsistencies between these figures and the monitoring wells are shown to have pressure transducers installed in Table 2-1.

The hydrograph for monitoring well MW16-8-19 is repeated several times in Figure 3-26. Table 2-1 shows that pressure transducers were installed in MW16-15-34, MW16-7-5 and MW16-18-6 and these are not shown in the referenced figures. Figure 3-24 includes a hydrograph for monitoring well MW16-17-5, however Table 2-1 shows that no pressure transducer was installed.

a. **Provide the hydrographs of monitoring wells MW16-15-34, MW16-7-5 and MW16-18- 6. In addition, clarify whether a pressure transducer was installed at MW16-17-5. If no transducer was installed at MW16-17-5 then correct and update the document.**

Response

a. There were errors that led to a discrepancy between TDR Update (see Alberta Transportation's response to Round 1 AEP IR42, Appendix IR42-1), Figure 3-24, Figure 3-25, and Figure 3-26 compared to page 3.50, page 3.52 and Table 2-1, page 2.7.

   A pressure transducer was installed in MW16-17-5 and not in MW16-7-5. Also, a pressure transducer was installed in MW16-18-10 and not in MW16-18-6. These errors have been corrected in Table 7-1 (indicated by **red** text).

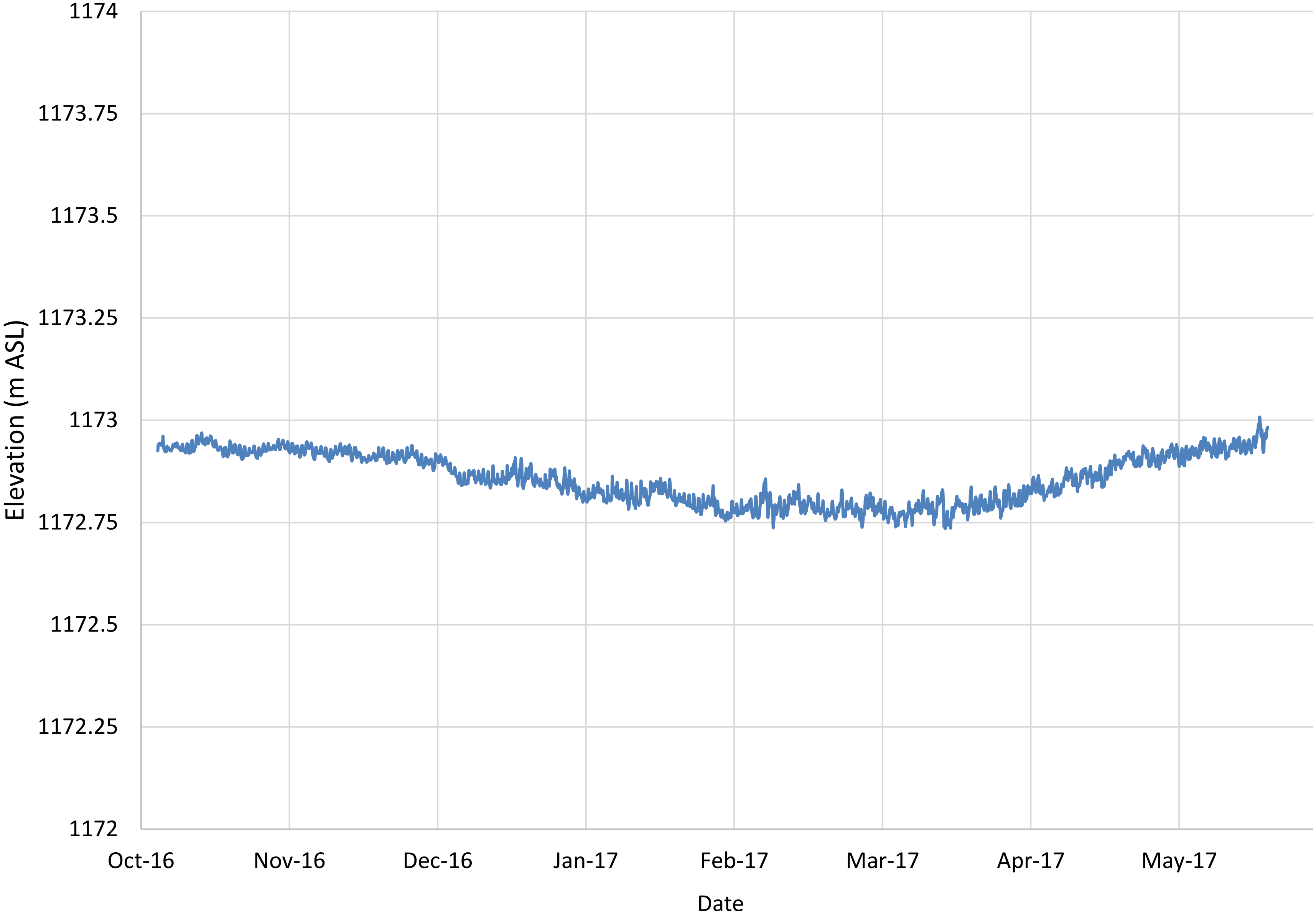
   The hydrograph for MW16-8-19 appears in Figure 3-25 and Figure 3-26 multiple times as an error and, as a result, the hydrographs for MW16-15-34 and MW16-18-10 were not included. These two hydrographs are provided in Figure 7-1 and Figure 7-2.

Table 7-1 Monitoring Well Completion Details

Well Name	Borehole Name	3TM East[1]	3TM North[1]	Ground Elevation (m ASL)	Total Borehole Depth (m BGL)	Screen from (m BGL)	Screen to (m BGL)	Water Level Elevation - September 2016 (m ASL)	Completion Unit	Pressure Transducer/ Logger Installed	Response Test Completed
MW16-1-15	GW1	5659967.3	-33327.5	1211.71	16.8	12.2	15.2	1207.83	Sandstone	Yes	Yes
MW16-2-6	GW2	5659623.9	-31947.3	1204.26	13.7	3.1	6.1	1203.52	Glaciolacustrine Clay		
MW16-3-7	GW3	5659073.5	-31904.4	1201.07	7.6	3.7	6.7	1199.89	Glaciolacustrine Clay and Silt		
MW16-4-22	GW4	5658717.4	-32259.3	1204.30	22.9	18.6	21.6	1200.97	Sandstone		Yes
MW16-5-11	GW5	5658164.7	-31863.2	1210.63	22.9	8.2	11.3	1208.32	Sandstone		
MW16-6-11	GW6S	5658135.3	-31100.5	1195.44	10.7	7.3	10.4	1195.28	Glacial Till	Yes	
MW16-6-20	GW6D	5658133.9	-31100.4	1195.51	22.9	18.9	21.9	1195.37	Claystone/Siltstone	Yes	Yes
MW16-7-5	GW7	5658895.2	-31098.8	1199.28	9.1	2.1	5.2	1198.14	Glaciolacustrine Clay and Silt		
MW16-8-8	GW8S	5659641.1	-30875.7	1218.16	7.9	6.1	7.6	1212.02	Glacial Till	Yes	
MW16-8-19	GW8D	5659641.2	-30877.5	1218.13	20.4	16.5	18.6	1213.88	Sandstone	Yes	Yes
MW16-9-6	GW9	5659076.8	-30236.4	1204.52	6.1	4.3	5.8	1204.29	Glaciolacustrine Clay and Silt		Yes
MW16-10-15	GW10	5658478.2	-30461.4	1195.40	18.3	12.2	15.2	1192.75	Glacial Till		Yes
MW16-11-15	GW11	5657742.9	-30269.8	1193.68	15.2	11.6	14.6	1193.06	Glacial Till		
MW16-12-3	GW12	5657858.3	-29160.3	1189.98	12.2	1.5	3.1	1187.23	Glacial Till	Yes	
MW16-13-37	GW13	5659064.0	-29610.3	1222.34	37.2	33.5	36.6		Claystone		
MW16-14-33	GW14	5659018.4	-28592.2	1202.24	33.5	30.5	33.5	1175.75	Siltstone/Claystone		
MW16-15-34	GW15	5658214.9	-27818.8	1190.10	35	32.9	34.4	1172.94	Siltstone	Yes	
MW16-16-11	DC-9	5655154.3	-33453.6	1227.47	14.1	7.6	10.7	1226.12	Glacial Till		
MW16-17-5	DC-15	5656140.6	-33226.5	1213.52	11.2	3.7	5.2	1208.97	Glaciolacustrine Clay	Yes	
MW16-18-6	DC-21S	5656749.5	-32406.6	1216.04	6.1	4	5.5	1212.69	Basal Silt and Sand		
MW16-18-10	DC-21D	5656750.6	-32406.7	1216.03	12.5	9.1	10.6	1212.94	Claystone	Yes	Yes
MW16-19-8	DC-25S	5657262.2	-31684.6	1202.73	7.6	6.1	7.6	1198.88	Basal Silt and Sand		
MW16-19-19	DC-25D	5657263.2	-31684.5	1202.80	23.2	17.1	18.6	1200.02	Sandstone		Yes
MW16-20-21	D2	5657498.6	-31218.4	1206.60	21.3	19.8	21.3	1191.40	Sandstone		
MW16-21-11	D9	5656987.1	-30383.8	1202.61	14.1	9	10.5	1193.00	Sandstone		
MW16-22-26	D27	5656907.3	-29330.9	1190.70	27.4	22.9	25.9	1182.94	Glacial Till		
MW16-23-14	D36S	5657309.6	-29019.7	1190.54	14.0	11.0	14.0	1186.74	Glacial Till		
MW16-23-36	D36D	5657308.3	-29019.3	1190.56	45.7	35.7	37.2	1187.18	Siltstone		
MW16-24-30	D51	5657740.5	-28761.8	1194.50	30.8	29	30.5	1186.37	Sandstone		Yes
MW16-25-9	BS3	5658231.0	-29274.7	1197.44	9.4	6.1	9.1	1190.50	Glacial Till		Yes
MW16-26-18	H6	5659178.1	-32702.7	1204.56	18.3	15.8	18.3	1204.41	Claystone	Yes	
MW16-27-12	H9	5659766.2	-32702.3	1207.67	18.9	10.1	11.6	1207.45	Glacial Till		

[1] Coordinate system is NAD83 3TM 114

Figure 7-1. MW16-15-34 Groundwater Elevation



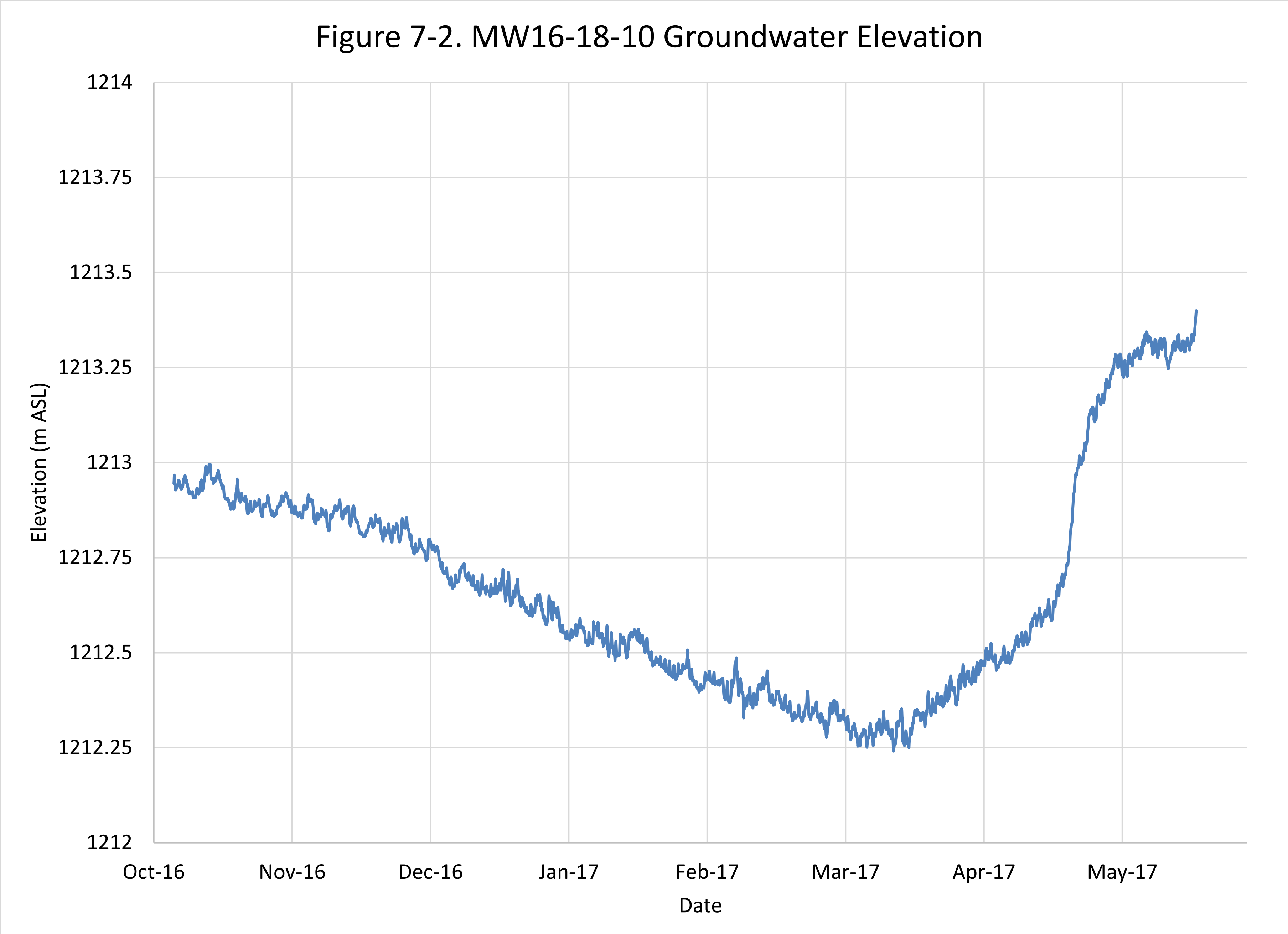


Figure 7-2. MW16-18-10 Groundwater Elevation
Elevation (m ASL)
1214
1213.75
1213.5
1213.25
1213
1212.75
1212.5
1212.25
1212
Oct-16
Nov-16
Dec-16
Jan-17
Feb-17
Mar-17
Apr-17
May-17
Date

Question 8

Supplemental Information Request 1, Question 42, Page 2.66
Supplemental Information Request 1, Appendix IR42-1, Section 5 and Figure 5-13, Page 5.1 to 5.26

Appendix IR42-1, Section 5 summarizes the predicted effects of the project on water levels. Appendix IR42-1, Figure 5-13 displays simulated head increase up to 24m in the reservoir, yet after timestep 650 there is less than 0.5m of head increase adjacent to the reservoir.

a. Confirm the elapsed time associated with timestep 650.

b. Discuss why is there no propagation of drawdown away from the reservoir in Figure 5- 13. Comment on whether the lack of drawdown has been validated by approximating the problem with an analytical solution.

c. Discuss whether the settings that control the behavior of the phreatic surface are adversely affecting the simulated response to flooding.

Response

a. Each timestep is 0.5 hours. Therefore, timestep 650 represents an elapsed time of 325 hours from the start of the simulation run.

b. Propagation of groundwater level increases (i.e., a rise in the water table) away from the reservoir is limited by the low conductivity of the underlying material and the limited residence time of the water in the reservoir. The entire reservoir is underlain by both glaciolacustrine clay and till units, which are characterized as aquitard units, thus limiting the vertical recharge rate from the reservoir (when in operation) to the underlying aquifer. The low conductivity and transmissivity of these aquitard units, along with the relatively low conductivity of the upper bedrock, limits the propagation of effects on the water table away from the reservoir.

   The limited spatial extent of groundwater level increase away from the reservoir has been estimated using an analytical solution (in additional to the numerical model already presented). The analytical solution is based on a solution by Hantush (1967) for mounding calculations beneath a rectangular recharge area. The following parameter values were used in the analytical calculation:

   - aquifer hydraulic conductivity (K) = were varied from 1.4E-5 m/s to 1.4E-7 m/s to represent a potential range of values for sensitivity analysis
   - specific yield (Sy) = 0.17
   - recharge rate when reservoir is full = 6.75E-05 m/min

- length of the recharge area (X) = 5,000 m (idealized from the reservoir footprint)
- width of the recharge area (Y) = 2,000 m (idealized from the reservoir footprint)

Figure 8-1 through Figure 8-3 present the results of the analytical solution using the varied hydraulic conductivity values for the aquifer unit. Calculated hydraulic head profiles are presented for 42 days of retention in the reservoir, full level, and after 100, 365, and 1,000 days following release of retained water from the reservoir.

Figure 8-1 presents an idealized cross-section through the edge of the reservoir area showing the change in hydraulic head over space and time using the calibrated hydraulic conductivity (derived from the numerical groundwater flow model) of the upper bedrock aquifer (1.4E-6m/s).

Figure 8-1 shows that the analytical solution predicts that increases in groundwater levels greater than 0.5 m are limited to distances of approximately 150 m beyond the edge of the reservoir. The analytical solution, therefore, supports the limited propagation of effects similarly predicted in the numerical modelling results: in both the numerical model and the analytical solution, the effects of water level increases are limited to within the local area.

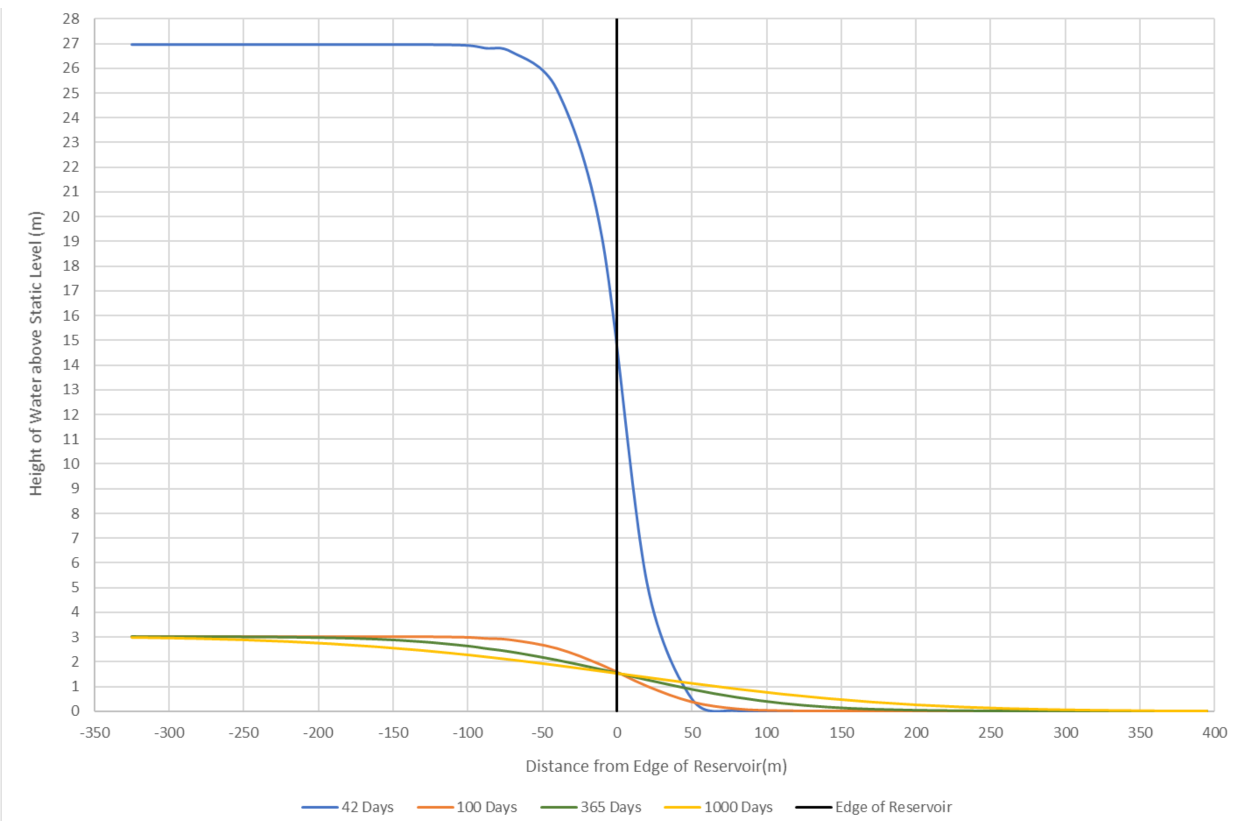


Figure 8-1 Estimated Change in Hydraulic Head at the Edge of the Reservoir using an Analytical Solution (Aquifer K = 1.4E-06 m/s)

The sensitivity of the analytical solution to changes in hydraulic conductivity is shown in Figure 8-2 and Figure 8-3. Figure 8-2 presents the results of the analytical solution using an order of magnitude lower hydraulic conductivity value of 1.4 E-7 m/s. The lower conductivity results in propagation of groundwater increases greater than 0.5 m to approximately 50 m from the edge of the reservoir.

In Figure 8-3, The propagation of effects predicted using the higher conductivity of 1.4 E-5 m/s shows increases of up to 0.5 m extending approximately 425 m from the edge of the reservoir.

As part of the numerical groundwater flow modeling, a similar sensitivity analysis was completed by varying the hydraulic conductivity of the subsurface units as were parameterized through calibration of the model. The sensitivity analysis conducted for both the analytical solution presented here, and the analysis conducted on the numerical model are in general agreement, indicating that the spatial extent of changes in groundwater levels are directly affected by the hydraulic conductivity assigned. However, in both analytical and numerical model simulations, effects on groundwater levels are limited to areas within the LAA over the range of values applied.

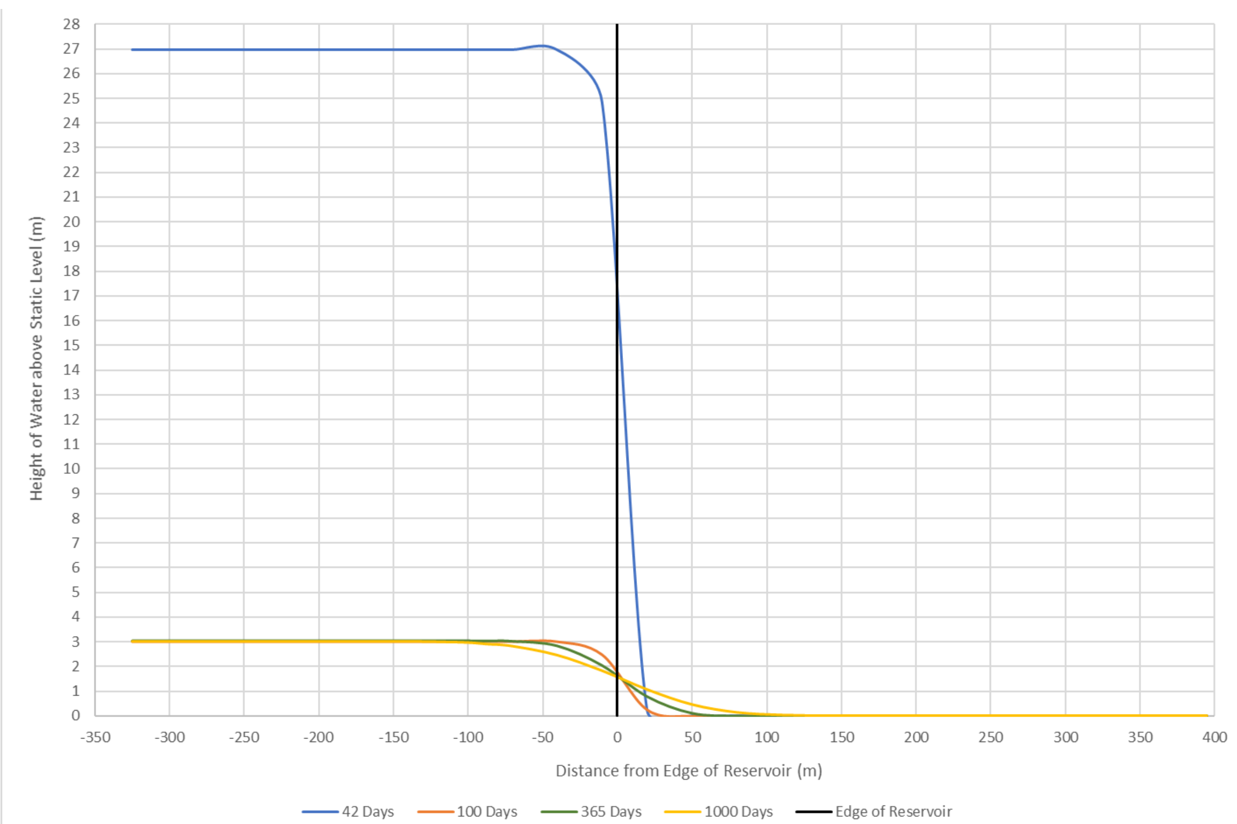


Figure 8-2 Estimated Change in Hydraulic Head at the Edge of the Reservoir using an Analytical Solution (Aquifer K = 1.4E-07 m/s)

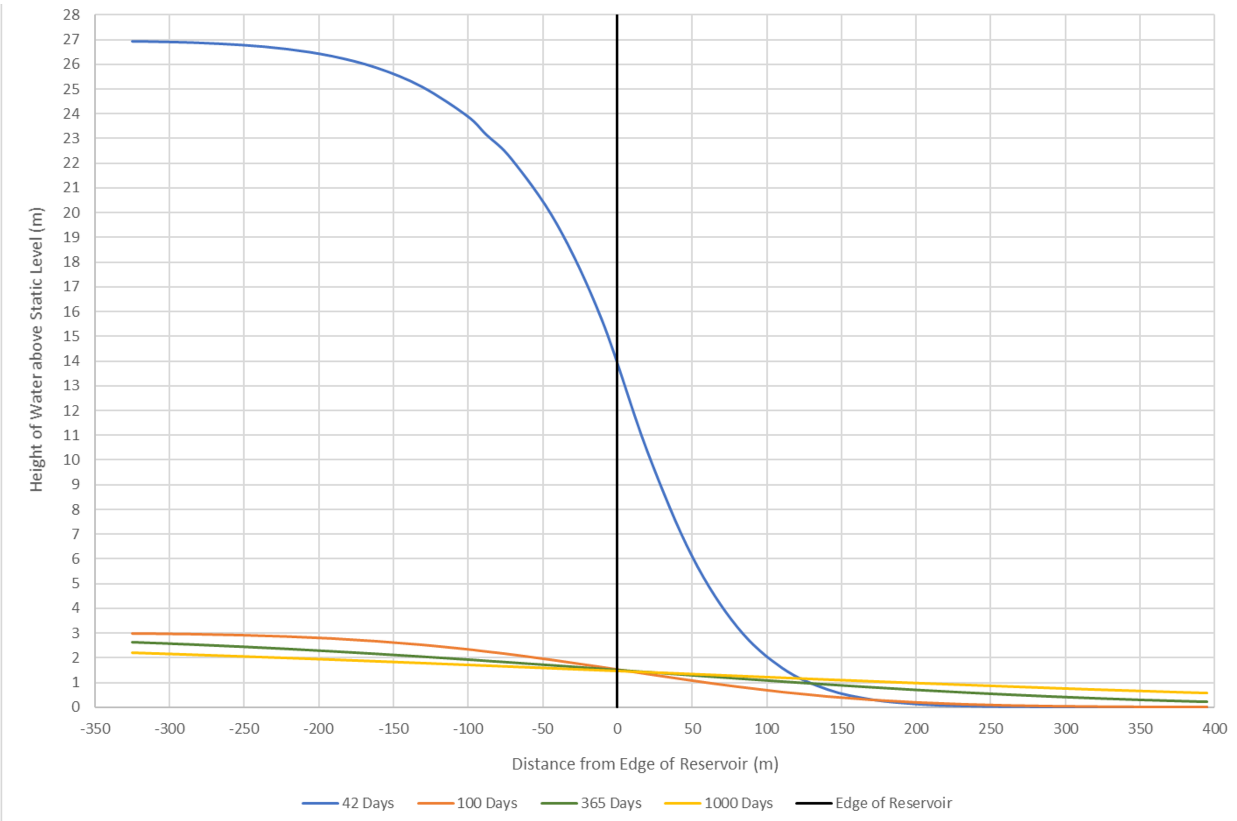


Figure 8-3 Estimated Change in Hydraulic Head at the Edge of the Reservoir using an Analytical Solution (Aquifer K = 1.4E-05 m/s)

c. When assigning the settings for the mode of behavior for the uppermost layer in the numerical model, three options within FEFLOW are available (phreatic, free and movable, and confined) and were considered for application in the numerical model. Selection of the most representative setting considered the regional groundwater flow regime, as was characterized during the baseline assessment, which was in general interpreted to be a semi-confined groundwater system with groundwater flow converging toward the Elbow River valley.

Water table conditions in the uppermost layer in the model domain are best represented by using phreatic mode settings in the FEFLOW model. The phreatic mode setting in FEFLOW is applicable to an unconfined layer and typically only applicable to the top slice or layer of the model. In phreatic mode, the model stratigraphy is not changed if the position of the water table changes relative to the model layers. As a result, partially saturated or unsaturated elements may occur in the model domain. If that happens during simulations, they are simulated by applying a partial-saturation approach; In partially dry elements, the conductivity in the element (in all directions) is reduced by multiplying the saturated conductivity with the saturation of the element. Saturation is calculated from the saturated thickness divided by element height. For completely dry elements (where hydraulic head is lower than the elevation of the bottom nodes), a minimum (residual) saturated thickness is used for the saturation calculation, known as the residual water depth. The residual water depth (by default, approximately 1 mm) is constant over the entire model domain.

There are other possible settings that can be used to describe the behavior of the top layer of the model. The closest alternative to phreatic mode is free and moveable mode. This mode is only available for the top slice of the model. In this mode, a movable slice tops an unconfined layer and follows the water table according to the free and movable method. The phreatic surface is considered by moving the top boundary of the model in a way that the elevation of the first model slice always corresponds to the water table elevation.

In a case where the water table drops below the first model layer, not only the first slice is moved, but underlying, dependent model layers may also move as a result. At each time step during simulations, material properties for each element are determined by the actual location of each computational layer during the timestep. For example, if the entire first stratigraphic layer is dry, the first computational layer will be in the second, underlying stratigraphic layer, inheriting all material properties of this layer. As the technique for moving the slices (known as best adaptation to stratigraphic data (BASD)) focuses on original slice elevations, for most of the elements this inheritance in parameters is unambiguous. However, in elements where the computational slice crosses an original slice location, an averaging of parameters from upper and lower layers is calculated. As a simple average is used, this can lead to making an aquitard overly conductive by artificially increasing its low conductivity values. As such, in an attempt to avoid this condition from happening, the free and moveable mode was not selected for use over the phreatic mode.

The third option for the setting in the top layer is the confined mode. This model setting applies only if there is confidence that the groundwater system is a confined aquifer system, which is not the case at a regional scale in the Elbow River valley system. In this mode, a confined slice cannot move. The layer below a confined slice is always treated as fully saturated. However, this mode does not represent conditions in the region, and it was not selected for use over the phreatic mode.

REFERENCES

Hantush, M.S., 1967. *Growth and decay of groundwater mounds in response to uniform percolation*, Water Resources Research, vol. 3, no. 1, pp. 227-234.

Question 9

Supplemental Information Request 1, Question 258, Page 5.57
Supplemental Information Request 1, Appendix IR42-1, Figure 5-4, Page 5.7

No time series plots are provided for the Points of Interest in Appendix IR42-1, Figure 5-4.

a. Provide the plots requested in Question 258.

Response

a. Figure 9-1 presents the locations of the points of interest (POI). The following discussion presents time series hydrographs for POI in areas near the diversion channel and reservoir. All timesteps referenced in Figure 9-2 to Figure 9-6 are one-hour increments of elapsed time since the start of the simulation for the design flood.

Figure 9-2 presents hydrographs for three POI (24, 25 and 26) near the north side of the diversion channel. Point 26 shows the response to water levels in the channel resulting from the diversion of water from Elbow River. Point 25 is located approximately 10 m north of Point 26 and shows a delayed and dampened response, increasing approximately 4 cm beginning at timestep 605, followed by a gradual increase of 6 cm by timestep 1,300 (the end of the simulation). Point 24, located approximately 20 m from the channel, shows further dampening with effectively no response immediately after the diversion begins, followed by a lagged 8 cm increase by timestep 1,300.

Figure 9-3 presents hydrographs for POI on the south side of the diversion channel. The results are similar to observations for the north side of the diversion channel, although a more immediate and higher magnitude response is observed at the nearest point (Point 27) to the channel. Point 27 on the south edge of the channel shows the water level response due to the diversion of water within the channel. Point 28 is located approximately 10 m from the channel and shows a dampened response, increasing a maximum of 60 cm between timestep 605 and 616, but decreasing over the remainder of the simulation. At Point 29, located approximately 20 m from the channel, no response to the diversion of water is observed.

Figure 9-4 presents hydrographs for POI on the southeastern edge of the off-stream reservoir. Point 38 shows the response to the reservoir water reaching a maximum level of 1,207.3 m asl during the design flood, and following release of the water, remaining near the ground surface after the design flood has passed (to simulate continued near surface saturation). At Point 39, located approximately 10 m from the reservoir, an increase in hydraulic head of 2.1 m is followed by a gradual decrease (once water is released after the design flood) over the remainder of the simulation. Further dampening of effects on water levels is observed away from the reservoir, with only approximately 0.30 m of change at Point 40, located approximately 17 m southeast from the reservoir. The hydraulic head at Point 40 reaches a peak at timestep 900 and decreases gradually over the remainder of the simulation.

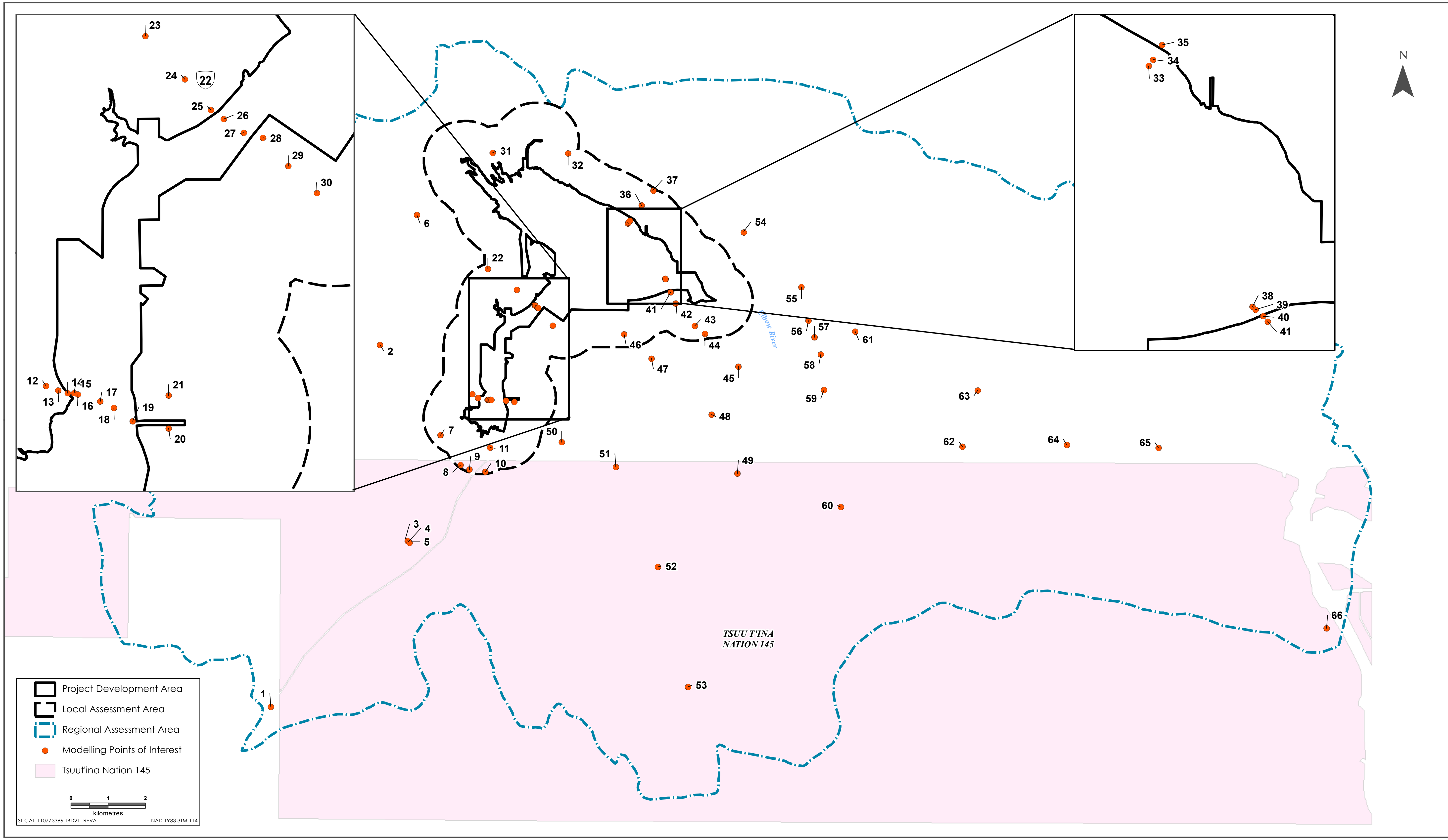
Figure 9-5 presents hydrographs for POI on the northeastern edge of the reservoir. Point 33 shows the response to retention of water when the reservoir water reaches a maximum level of 1,207.3 m asl (during the design flood) and remaining near the ground surface after the design flood has passed. At Point 34, located approximately 35 m from the reservoir, a maximum increase in hydraulic head of 0.56 m is followed by decreasing levels after the design flood has passed for the remainder of the simulation. Further dampening is observed away from the reservoir, with essentially no change in water levels noted during the design flood at Point 35, located approximately 90 m from the reservoir.

Figure 9-6 presents hydrographs for POI near Elbow River south of the LAA. Hydraulic head changes are observed in the alluvium as a result of changes in river stage during the design flood. Point 3, adjacent to the river, shows the response to the specified head over the transient flooding simulation. Point 4 and Point 5 show an initial increase between timestep 500 to 600 when the simulation is adjusting from the steady state hydraulic head values to the transient head values specified for the river. Following the initial increase, the dampening effect is observed in the sand and gravel aquifer at distances of 30 m and 60 m from the river, respectively.

The remaining POI are distributed throughout the model domain and show similar responses to those summarized above.

Table 9-1 presents a summary of the POI responses which can generally be categorized as follows:

- The response due to diversion or water retention is related to POI within areas where Project effects are observed.
- The response due to Elbow River water level change is related to POI within the area where changes resulting from transient boundary conditions in the river are observed.
- No response is related to POI where no Project effects are observed and no change due to river stage is observed.



Sources: Base Data- Government of Alberta, Government of Canada. Thematic Data - Stantec Ltd.

Stantec

ALBERTA TRANSPORTATION SPRINGBANK OFF-STREAM RESERVOIR PROJECT ENVIRONMENTAL IMPACT ASSESSMENT

Points of Interest Used for Interpretation of Time-Series Evaluation

Figure 9-1

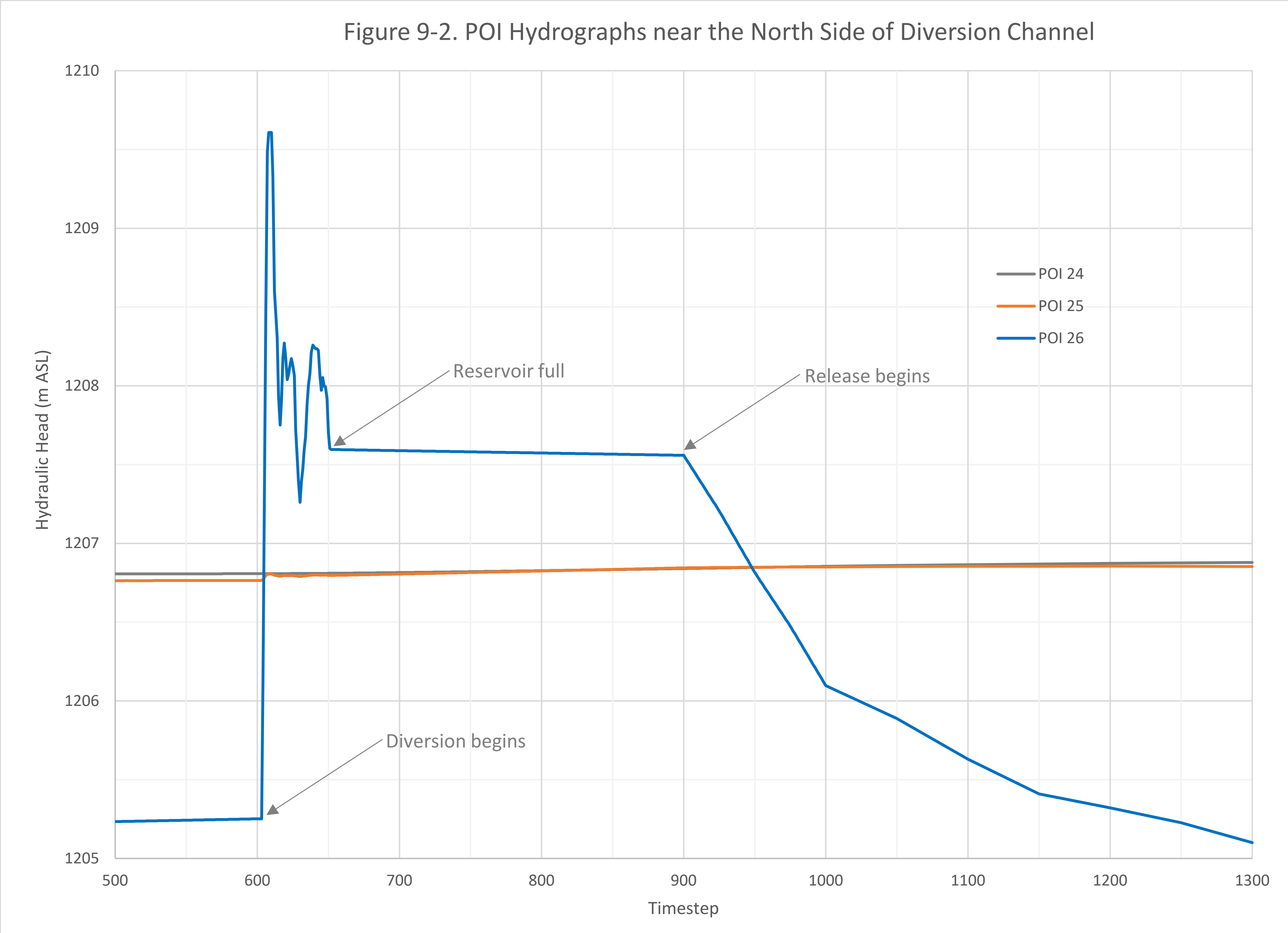


Figure 9-2. POI Hydrographs near the North Side of Diversion Channel
1210
1209
1208
1207
1206
1205
Hydraulic Head (m ASL)
500
600
700
800
900
1000
1100
1200
1300
Timestep
POI 24
POI 25
POI 26
Reservoir full
Release begins
Diversion begins

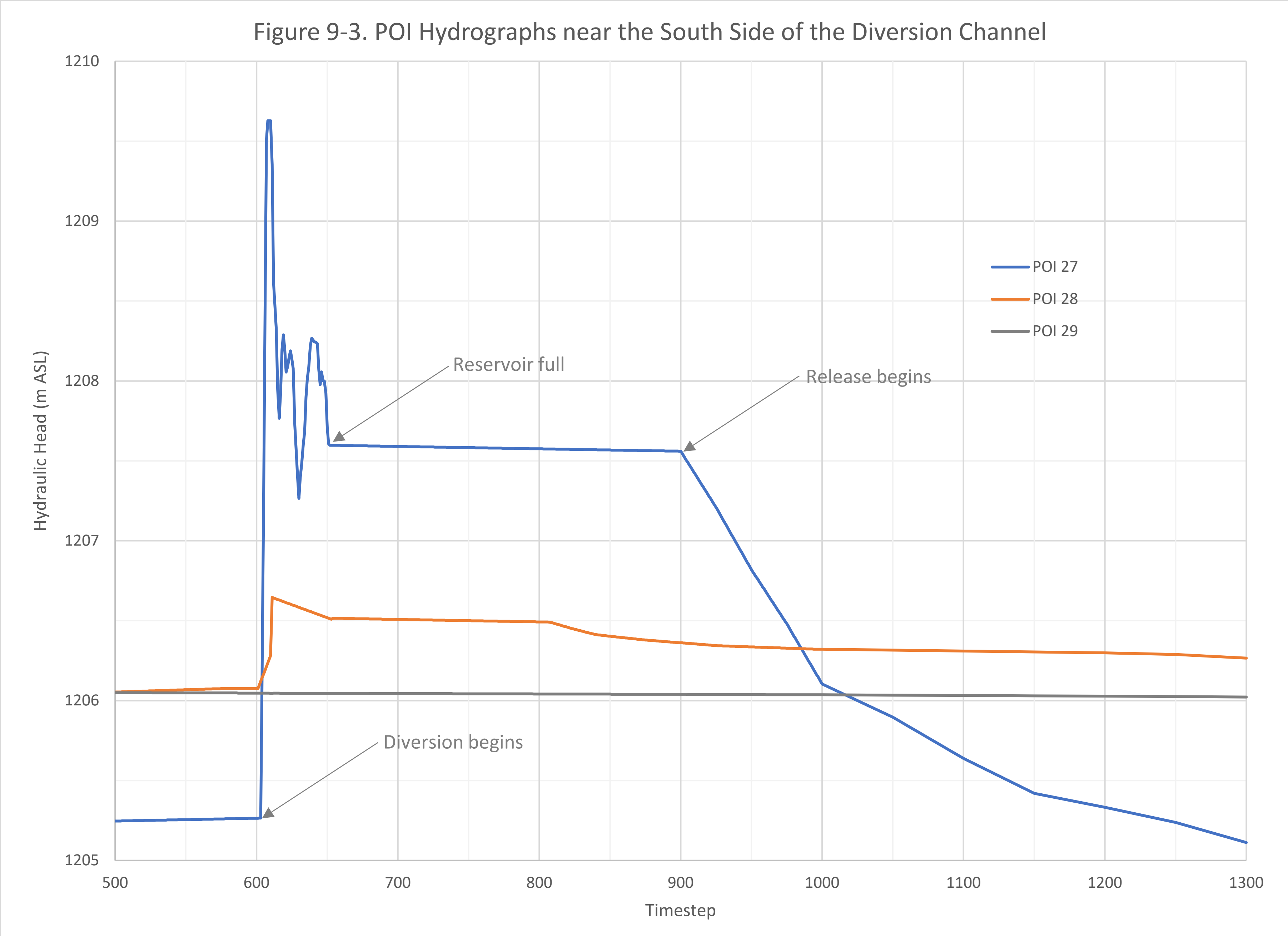


Figure 9-3. POI Hydrographs near the South Side of the Diversion Channel
Hydraulic Head (m ASL)
1210
1209
1208
1207
1206
1205
500
600
700
800
900
1000
1100
1200
1300
Timestep
POI 27
POI 28
POI 29
Reservoir full
Release begins
Diversion begins

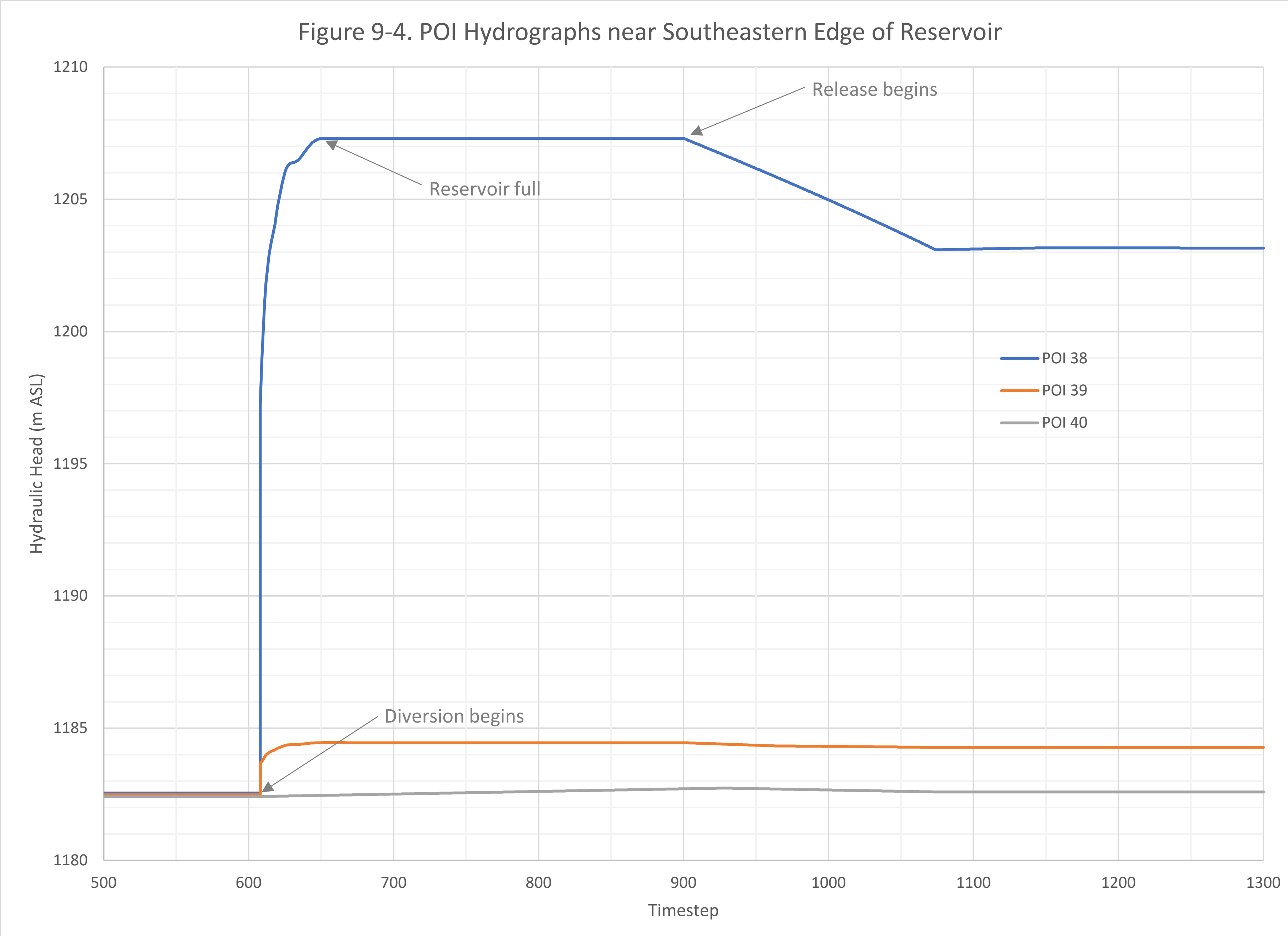


Figure 9-4. POI Hydrographs near Southeastern Edge of Reservoir
1210
1205
1200
1195
1190
1185
1180
Hydraulic Head (m ASL)
500
600
700
800
900
1000
1100
1200
1300
Timestep
Release begins
Reservoir full
Diversion begins
POI 38
POI 39
POI 40

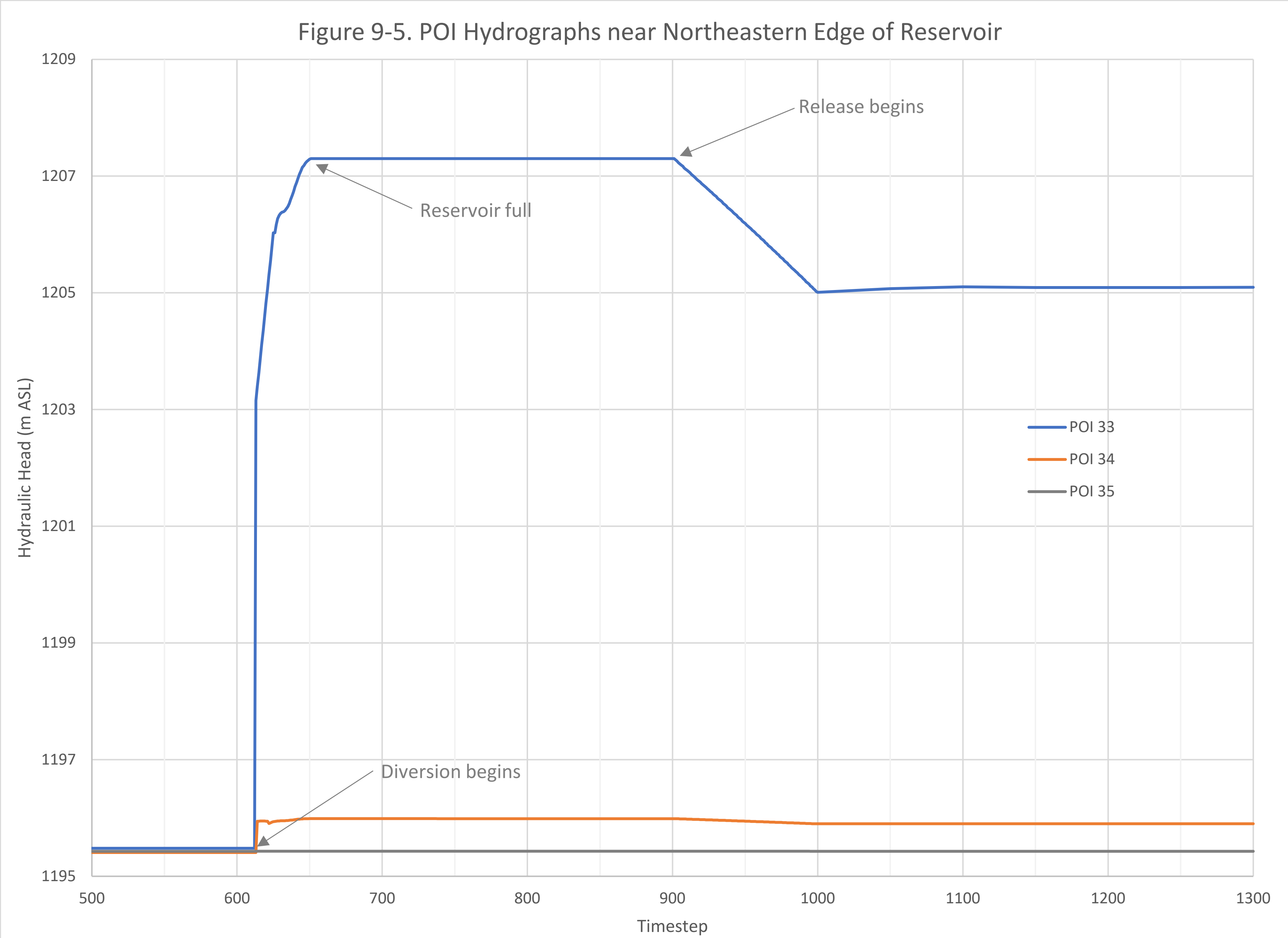


Figure 9-5. POI Hydrographs near Northeastern Edge of Reservoir
Hydraulic Head (m ASL)
1209
1207
1205
1203
1201
1199
1197
1195
500
600
700
800
900
1000
1100
1200
1300
Timestep
Release begins
Reservoir full
Diversion begins
POI 33
POI 34
POI 35

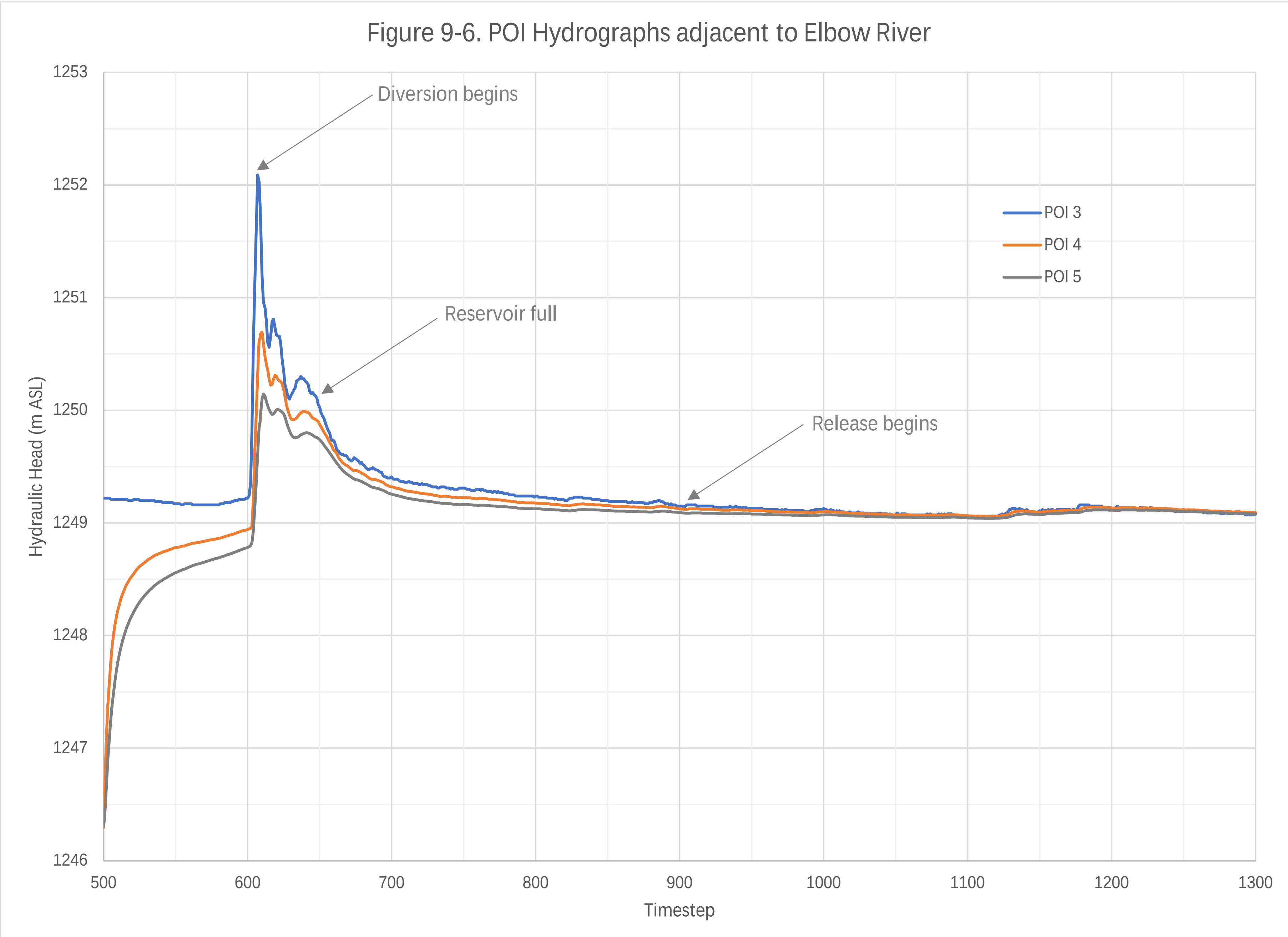


Figure 9-6. POI Hydrographs adjacent to Elbow River
Diversion begins
Reservoir full
Release begins
POI 3
POI 4
POI 5
Hydraulic Head (m ASL)
1253
1252
1251
1250
1249
1248
1247
1246
500
600
700
800
900
1000
1100
1200
1300
Timestep

Table 9-1 Summary of POI Hydrograph Response

Point of Interest	No Response	Flood Response	Response Due to Diversion or Water Retention in the Reservoir
1		X	
2	X		
3	X		
4		X	
5	X		
6	X		
7	X		
8		X	
9		X	
10			X
11		X	
12	X		
13	X		
14		X	
15		X	
16		X	
17		X	
18		X	
19		X	
20		X	
21		X	
22	X		
23	X		
24	X		
25			X
26			X
27			X
28			X
29	X		
30	X		
31	X		
32	X		
33			X
34			X

Table 9-1 Summary of POI Hydrograph Response

Point of Interest	No Response	Flood Response	Response Due to Diversion or Water Retention in the Reservoir
35	X		
36	X		
37	X		
38			X
39			X
40			X
41	X		
42		X	
43		X	
44	X		
45	X		
46		X	
47	X		
48	X		
49	X		
50	X		
51	X		
52	X		
53	X		
54	X		
55	X		
56		X	
57		X	
58	X		
59	X		
60	X		
61	X		
62	X		
63		X	
64		X	
65		X	
66	X		

Question 10

Response to CEAA IR, Package 3, Response IR3-17c, Page 68

Alberta Transportation states *given the intent of the model is to examine potential Project effects, it is not necessary to apply a variable recharge rate since it would not materially affect the net change in head when comparing pre-Project to post-Project conditions.*

a. Explain whether the effects of the off-stream reservoir can be evaluated adequately without changing the areal recharge rate.

Response

a. Effects related to operation of the off-stream reservoir can be evaluated without applying a temporally variable recharge rate. Groundwater recharge rates will vary over time regardless of Project operations because the recharge rates are influenced largely by external factors, including local climate conditions. Application of a constant areal recharge rate is considered appropriate for the numerical model and is representative of average conditions across the model domain. The intent of the effect's assessment is to compare pre-Project (existing conditions) to post-Project conditions. If the same temporally variable recharge rate were applied to both pre- and post-Project scenarios, it would not materially affect the net change in hydraulic head. In other words, if there are changes to the local groundwater levels as a result of variable recharge, those changes are not a result of Project operations, and therefore not related to Project effects.

Question 11

Supplemental Information Request 1, Question 253, Page 5.52
Supplemental Information Request 1, Appendix IR42-1, Section 2.2, Page 2.2, Section 4.4.1, Page 4.13, and Section 4.4.2, Page 4.20

Appendix IR42-1 describes the use of several types of specified head and specified flux boundary conditions. In section 4.4.1 of Appendix IR42-1 Alberta Transportation describes the use of specified hydraulic head boundaries *set within all model layers around the perimeter of the model domain*. Section 4.4.2 describes the assignment of a specified flux to the top slice of the numerical model to simulate recharge. In Appendix IR42-1, Section 2.2 describes the selection of the RAA boundaries to coincide with surface and groundwater flow divides in many parts of the model.

a. Groundwater flow divides represent areas of zero horizontal groundwater flux. Provide the rationale for applying specified hydraulic heads (a potentially infinite source/sink of water) to areas that are interpreted to be groundwater flow divides.

b. Provide detail on how the aerial recharge and specified head boundaries interact in each area of the model. Provide a steady state flow budget summarizing the flux at all model boundaries and showing the net water balance. Separate the surficial sediments from the bedrock boundaries in the flow budget.

c. Clarify whether the extensive use of specified hydraulic heads limits the capacity of the model to properly calibrate hydraulic conductivity and recharge. Provide details of the model sensitivity to the adjustable parameters including a table showing the local sensitivity of parameter values to steady state calibration data.

d. Comment whether the specified hydraulic heads around the model boundary in each layer affect the forward predictions of change in head during flooding. Provide a table or graph of the boundary conditions over time during the design flood event.

Response

a. The model domain for the groundwater regional assessment area (RAA) is based on the surface watershed boundary, which separates two neighbouring surface watersheds. In many cases, and at a regional scale, groundwater flow divides occur approximately beneath surface water divides. However, occasionally the groundwater divide may not coincide with the watershed boundary at the subwatershed scale. In that case, a recharge area for an aquifer in one watershed may extend partially into the adjacent watershed, and the type of boundary conditions that are specified along the perimeter of the domain would be different.

During development of the model, no-flow boundary conditions were first tested by assuming the groundwater divide and the surface water divide are in the same location during the steady state model calibration. The model performance was evaluated through examination of calibration residuals using both specified head and no-flow boundary conditions. The evaluation also included examination of Darcy fluxes at nodes around the perimeter of the domain. Through this evaluation, it was determined that the model better represented measured conditions through use of specified heads around the model perimeter. Throughout the calibration process, it was also noted the location of the regional groundwater flow divide along the Elbow River valley did not change, regardless of the specification of boundary condition type.

Specified hydraulic heads do not necessarily mean there is an infinite source or sink in the groundwater flow model. Fluxes of groundwater in and of the model domain are still constrained by the hydraulic conductivity of the geologic materials, which in most areas of the domain (aside from the fluvial sediments in the Elbow River valley) are relatively low. In turn, the majority of the total subsurface fluxes in the model are through the fluvial sediments present within the domain. In short, the use of specified head boundary conditions in the model does not unduly affect its ability to simulate changes in groundwater levels due to operation of the Project.

b. Areal recharge is defined in the model as a constant, distributed source parameter, rather than a node-based definition, as is the case for other boundary conditions. Water can enter the model domain through distributed recharge and enter and exit the model domain through inflows at specified head nodes and through lateral fluxes in and out of the system.

   Table 11-1 presents a summary of volumetric fluxes in, out, and within areas of the model domain during the calibrated steady state simulation. In addition to the total fluxes over the entire model domain, fluxes have also been separated into those within the fluvial unit, the clays/tills, and bedrock. Examination of the fluxes helps to understand how the different units within the domain interact with each other. Because the distribution of the geologic units is not contiguous across the domain for all units, in some areas the nature of the interactions is limited, as compared to other areas of the domain. For example, transfer of water in and out of the fluvial deposits can only occur within the limited, channel-confined areas where those deposits are present (e.g., generally limited to the Elbow River valley and within the unnamed creek in the reservoir area).

Table 11-1 Steady State Water Balances by Unit in the Modelling Domain

Units	Inflows (m^3/s)	Outflows (m^3/s)	Transfer between layers (m^3/s)	Balance (m^3/s)
Total model domain	2.062	2.060	N/A	0.002
Fluvial deposits	1.867	1.900	-0.033 (in)	–
Unconsolidated clays/tills	0.00003	0.00007	-0.00004 (in)	–
Bedrock	0.196	0.161	0.035 (out)	–
Summation	2.063	2.061	0.002	0.002
NOTES: N/A = not applicable; - = not calculated				

   The water balances are within acceptable levels when considered over the entire model domain. The fluxes indicate that the majority of the groundwater flow within the domain occurs within the more permeable fluvial unit. Fluxes through the low permeability clays and tills are relatively low and do not constitute a significant proportion of the total fluxes into the system.

c. Specified head boundary conditions are used at the model domain boundary, along Elbow River, and along smaller unnamed creeks. Use of specified head boundary conditions to represent these features does not limit the ability of the model to change heads during calibration or during latter simulation runs (i.e., the model is not excessively constrained). In order to demonstrate that the model is not unduly constrained by specified head boundary condition nodes, an additional steady state simulation was completed using hydraulic conductivity values that were (unrealistically) increased by a factor of 1,000 for all model units other than the alluvial unit. The results of this simulation confirm that the simulated head varied at almost all points by changing the parameters of the model. Table 11-2 presents the steady state heads and a comparison of residual values for both the final calibrated run and the sensitivity run completed to evaluate the model response.

Table 11-2 Comparison of Final Calibrated Heads and Sensitivity Run Heads

Calibration Point ID	Interpreted Head (m asl)	Calibrated Head (m asl)	Calibrated Residual (m)	Sensitivity Run with K x 1,000 Head (m asl)	Sensitivity Residual (m)	Change in Residual (m)
1	1330.26	1334.46	4.20	1320.39	-9.87	14.07
2	1361.43	1362.07	0.64	1362.07	0.64	0.00
3	1382.24	1391.63	9.39	1362.40	-19.84	29.23
4	1300.95	1300.99	0.04	1300.80	-0.15	0.19
5	1227.29	1229.58	2.29	1228.22	0.93	1.36
6	1246.93	1249.18	2.25	1243.76	-3.17	5.42
7	1182.86	1190.36	7.50	1189.27	6.41	1.08
8	1164.91	1177.52	12.61	1174.65	9.74	2.87
9	1132.71	1137.65	4.94	1134.29	1.58	3.36
10	1181.95	1184.83	2.88	1184.85	2.90	-0.01
11	1117.00	1123.27	6.27	1123.27	6.27	0.00
12	1110.85	1120.20	9.35	1109.71	-1.14	10.48
13	1105.19	1108.74	3.55	1108.74	3.55	0.00
14	1160.81	1166.27	5.46	1159.01	-1.80	7.26
15	1220.93	1225.16	4.23	1225.19	4.26	-0.03
16	1215.26	1227.94	12.68	1217.46	2.20	10.48
17	1243.81	1244.20	0.39	1232.51	-11.30	11.70
18	1236.33	1246.43	10.10	1230.73	-5.60	15.70
19	1228.81	1240.05	11.24	1226.71	-2.10	13.34
20	1161.71	1179.98	18.27	1176.45	14.74	3.53
21	1150.76	1165.84	15.08	1156.62	5.86	9.22

Table 11-2 Comparison of Final Calibrated Heads and Sensitivity Run Heads

Calibration Point ID	Interpreted Head (m asl)	Calibrated Head (m asl)	Calibrated Residual (m)	Sensitivity Run with K x 1,000 Head (m asl)	Sensitivity Residual (m)	Change in Residual (m)
22	1182.11	1193.73	11.62	1191.01	8.90	2.72
23	1173.73	1197.27	23.54	1181.10	7.37	16.17
24	1131.53	1159.67	28.14	1138.49	6.96	21.18
25	1141.89	1159.44	17.55	1130.38	-11.51	29.06
26	1104.37	1111.99	7.62	1108.70	4.33	3.29
27	1143.79	1156.17	12.38	1145.11	1.32	11.06
28	1183.33	1186.57	3.24	1183.90	0.57	2.66
29	1207.29	1210.35	3.06	1211.04	3.75	-0.69
30	1215.48	1221.06	5.58	1217.27	1.79	3.79
31	1255.60	1255.14	-0.46	1253.65	-1.95	1.49
32	1199.20	1205.13	5.93	1199.90	0.70	5.22
33	1219.80	1239.01	19.21	1232.77	12.97	6.23
45	1192.75	1195.00	2.25	1193.34	0.59	1.66
46	1193.06	1194.03	0.97	1190.86	-2.20	3.17
47	1207.83	1210.20	2.37	1208.31	0.48	1.90
48	1187.23	1189.60	2.37	1188.18	0.95	1.42
49	1226.12	1222.79	-3.33	1213.17	-12.95	9.62
50	1208.97	1209.38	0.41	1212.40	3.43	-3.02
51	1212.69	1210.65	-2.04	1208.40	-4.29	2.24
52	1198.88	1202.18	3.30	1202.18	3.30	0.00
53	1193.00	1195.86	2.86	1188.30	-4.70	7.56

Table 11-2 Comparison of Final Calibrated Heads and Sensitivity Run Heads

Calibration Point ID	Interpreted Head (m asl)	Calibrated Head (m asl)	Calibrated Residual (m)	Sensitivity Run with K x 1,000 Head (m asl)	Sensitivity Residual (m)	Change in Residual (m)
54	1186.74	1185.78	-0.96	1184.45	-2.29	1.33
55	1190.50	1191.67	1.17	1188.97	-1.53	2.71
56	1203.52	1204.01	0.49	1203.69	0.17	0.32
57	1209.22	1208.18	-1.04	1206.85	-2.37	1.34
58	1199.89	1200.16	0.27	1199.17	-0.72	0.98
59	1208.32	1203.91	-4.41	1198.05	-10.27	5.86
60	1195.28	1195.20	-0.08	1194.74	-0.54	0.46
61	1198.14	1198.79	0.65	1197.45	-0.69	1.34
62	1212.02	1217.55	5.53	1204.40	-7.62	13.15
63	1204.29	1204.07	-0.22	1195.18	-9.11	8.89
64	1175.75	1201.81	26.06	1188.15	12.40	13.66
65	1172.94	1190.55	17.61	1178.01	5.07	12.54
66	1191.40	1202.05	10.65	1193.72	2.32	8.33
67	1182.94	1183.26	0.32	1182.28	-0.66	0.99
68	1187.18	1185.78	-1.40	1184.44	-2.74	1.34
69	1186.37	1187.41	1.04	1185.70	-0.67	1.71
70	1204.66	1202.39	-2.27	1201.78	-2.88	0.61
71	1200.97	1202.27	1.30	1201.47	0.50	0.81
72	1213.88	1217.49	3.61	1204.40	-9.48	13.09

Of the 72 calibration points almost all the residuals (observed values minus simulation results) changed significantly. Only six of 72 points did not change because they are located near a specified head location near a river or creek. Points located near the Project infrastructure did change, indicating the model's ability to respond to potential Project effects without being constrained by constant head boundaries.

d. The specified hydraulic heads along the model boundary perimeter would not affect the simulation of effects around Project infrastructure during simulated flood operations. The model was developed at the regional scale so that potential boundary effects would not be propagated to the simulated heads near the off-stream reservoir and diversion channel areas, which are interior within the model domain.

Specified heads around the perimeter of the model domain were set to constant values for the transient simulations (i.e., the "hydrograph" for these boundary conditions would be a flat line). The exception would be for those nodes along the perimeter of the model representing Elbow River, where a time varying definition of the specified heads was applied. The "hydrograph" for the specified head nodes representing Elbow River were defined based on the hydrodynamic model simulations of the flood events derived from the surface water models. Figure 11-1, by way of example, presents a hydrograph for a time varying specified head node within Elbow River during the design flood.

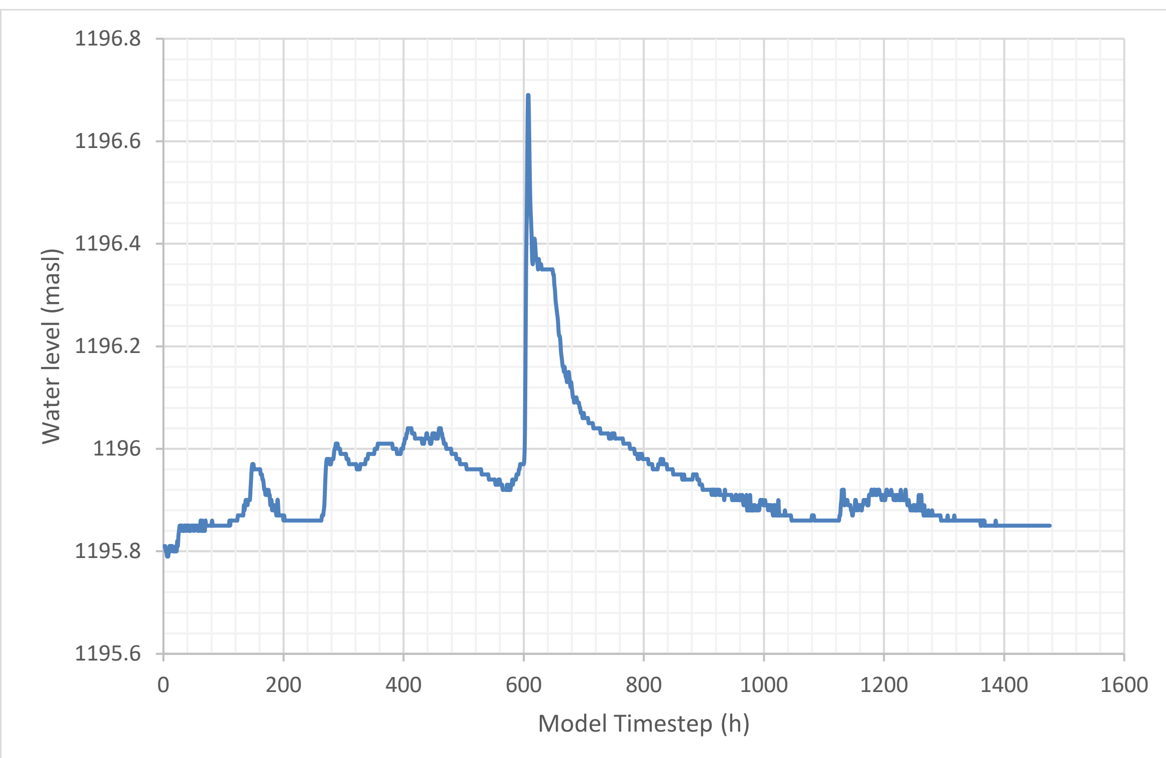


Figure 11-1 Time Varying Specified Head Conditions in Elbow River

Question 12

Supplemental Information Request 1, Question 56, Table IR56-1, Page 2.85

Alberta Transportation provided Table IR56-1 *Summary of Mean Peak Monthly Flow for Bragg Creek and Sarcee Bridge (1979-2016)*. Mean peak flows during the spring (April, May, and June) appear to be greater at Sarcee Bridge relative to at Bragg Creek (approximately 20%).

a. Provide an analysis of what this information provides in understanding the dynamics of flow (e.g., spring runoff, catchment areas, and storm events/floods, etc.) within the Elbow River and Elbow River watershed, particularly during May and June.

b. Describe how this information may affect specifics related to Project location, design, and to meet the purpose of the Project, including the modelling.

Response

a. In the EIA, Volume 3A, Section 6, mean monthly flow data, the standard deviation, monthly mean minimum and maximums and drainage areas were provided for the Bragg Creek and Sarcee Bridge Water Survey of Canada hydrometric stations in Elbow River. This data was then used to describe the hydrology of Elbow River.

Elbow River exhibits a runoff regime characterized by low winter discharges and spring runoff dominated by snowmelt. Mean average monthly flows and mean peak monthly flows show distinct runoff patterns at the two Water Survey of Canada stations, relative location to the Elbow River watershed. The two stations are Elbow River at Bragg Creek (ID 05BJ004) and Elbow River at Sarcee Bridge (ID 05BJ010); the stations monitor watershed areas of 790.8 km^2 and 1,189 km^2 respectively. The Bragg Creek station is geographically situated much closer to the mountains and, thus, reflects hydrology typical of mountainous catchments. The Sarcee station is located further downstream and, in addition to the mountains, is also influenced by plains landscape hydrology.

Winter flows at both stations are low, related to below freezing air temperatures and precipitation falling predominantly as snow. Spring flows increase first at Sarcee Bridge in March to April, which is a result of inputs land runoff over partially frozen ground with snowmelt occurring at progressively higher elevations in the upper basin as spring progresses. This pattern results in the snowpack in the non-mountainous part of the catchment being removed before the influx of most of the annual flow from the upper, and more mountainous, portions of the watershed in May, June and July.

Approximately 54% of the annual flow volume occurs during May, June and July in the Elbow River watershed. Of this percentage, 25% of the annual flow typically occurs in June alone. The higher mean average monthly and mean peak monthly flows and their standard deviation values for both stations evident in June indicates this is the primary month for flood occurrence. The higher variability is related to annual variability in the actual date of freshet start. Approximately 94% of the annual runoff is sourced from the watershed upstream of Bragg Creek, with 6% contributed from the plains over the year. In some months, there is a net loss of up to 1.0% between Bragg Creek and Sarcee Bridge, as also noted by Hudson (1983). This loss is likely due to infiltration into the alluvium of the Elbow River valley floor (Hudson 1983). Summer recession begins in June with a rapid decline towards October and November. Over the long term, the increase in discharge between Bragg Creek and Sarcee Bridge during the summer recession is likely a result of groundwater inflows, rather than rainfall inputs on the plains (Hudson 1983).

Hydrologic response of Elbow River to storm events shows that sustained rainfall from stationary frontal systems over the foothills and plains can result in increased runoff during the summer months. For example, field data collected from Elbow River at Highway 22 during 2015 and 2016 showed marked differences in flow volumes between the two years, as a function of snowpack and rainfall differences. In 2015, the flow volume for May and June were 17% and 23% of the total annual flow, with July at 13%. Flow volumes in 2016 were 17% of the total annual flow in May, 15% in June and 24% in July. The increase in flow during July 2016 was a result of approximately 206 mm of rain falling over the month, as recorded at Calgary International Airport. This rainfall amount represents a 208% increase over the 1981 to 2010 climate normal rainfall of 66.9 mm. This example illustrates that the timing and generating mechanism of flow events in the Elbow River can be quite variable.

Generation of high flow events in the Elbow River Basin are complex with changes in magnitude reflecting different combinations of driving mechanisms. Early spring floods driven by snowmelt alone are typically small and occur soon after ice break-up (Hudson 1983). Increasing flood magnitudes reflect an increasing rainfall contribution in the upper watershed with additional inputs from the lower watershed (Hudson 1983). High magnitude events occur when substantial rainfall occurs during spring melt when higher elevation snowpack is isothermal, or close to isothermal. For example, in June 2013, heavy rainfall and rapidly melting snowpack in the Front Ranges of the Canadian Rocky Mountains resulted in widespread flooding in multiple watersheds, including Elbow River. Over 200 mm, and as much as 350 mm, of precipitation fell in watershed headwaters between June 19 and June 20 (Pomeroy et al. 2016).

The intensity of the 2013 storm was the result of coupling between upper and lower circulation systems. This coupling resulted in upslope winds from the east that were warm and moist, which raised the freezing level and resulting in rainfall rather than snowfall at high elevations (Pomeroy et al. 2016. Snowmelt over partially frozen soil at higher elevations may have increased runoff by up to 30%, in some areas (Pomeroy et al. 2016). The system persisted for over 36 hours (Pomeroy et al. 2016). Localized pockets of high intensity, convection-driven rainfall over the foothills and plains, as well as in the upper Elbow River watershed, also contributed to extreme runoff conditions. Pomeroy et al. (2016) concluded that the generation of high magnitude floods in the Elbow River watershed typically requires a combination of snowmelt, rainfall and rain-on-snow.

b. The Project has been designed to reduce flood flows in Elbow River regardless of when the flooding may occur. Mean monthly peak flows were not used in assessing Project location, design or purpose. The information presented in the response to a. does not affect the requested specifics.

   The location of the Project was decided based on topographic constraints and, specifically, the presence of the natural off-stream basin that could be used for the off-stream reservoir. Its position relative to Elbow River allows the diversion of flood water by gravity from the river to the reservoir. The Project design capacity is the flood of record that occurred in 2013 and equivalent events. The annual flood magnitudes, flood frequency (return period) and the mean monthly spring run-off values—while utilized for the assessment of impacts as described in the EIA hydrology assessment—did not need to be factored into this design basis. The Project will divert all flood flows in excess of 160 m^3/s up to a maximum diversion flow capacity of 600 m^3/s regardless of when such events occur.

REFERENCES

Hudson, H.R. 1983. Hydrology and sediment transport in the Elbow River basin, S.W. Alberta. Ph.D. Thesis, The University of Alberta, Edmonton, Alberta.

Pomeroy, J.W., Stewart, R.E., Whitfield, P.H. 2016. The 2013 flood event in the South Saskatchewan and Elk River basins: Causes, assessment and damages. Canadian Water Resources Journal 41: 105-117

Question 13

Supplemental Information Request 1, Question 59, Page 2.91

Alberta Transportation states that *runoff simulations for the tributaries were modelled for contributions to the diversion channel and reservoir without diversion operations. A 1 :10 year, 24-hour rain event was used to develop flow and stage hydrographs and asses peak inflow into the outlet structure. During this event, the maximum flow rate from the reservoir is 13.3 m³/s.*

a. **Clarify in detail if similar percentage contributions from tributaries are to be diverted into the reservoir for the design flood and 1:100 year flood, and if these volumes were considered in designing the size/capacity of the reservoir (e.g., 13.3 m^3/s from the tributaries in a 1:10 year flood without diversion and a maximum diversion rate from the Elbow River for a 1:10 year flood is approximately 40 m^3/s, for a resulting total inflow to the reservoir of 53.3 m^3/s).**

Response

a. Provision for runoff from these tributaries is included in the sizing of the reservoir's active flood storage capacity (design volume). When assessing the stored volume of water from a 1:100 year flood, the runoff volume from one in 100 year, 6-hour rain event falling on those tributary catchments was added to the volume diverted from the river for a 1:100 year flood. The runoff simulation analysis was completed for stormwater contributions of the intersected tributaries during dry operations. A one in 10 year, 24-hour rain event is not analogous to a 1:10 year flood flow in Elbow River.

   For the design flood, the amount of rainfall that fell on these upstream tributaries in 2013 was less than the amounts computed for the one in 100 year, 6-hour rainfall event. As a conservative approach (overestimating the tributary contribution) to the sizing of the reservoir, the one in 100 year, 6-hour rainfall runoff totals were added to the total volume diverted from the river in the 2013 flood simulations; this allowed determination of the total active reservoir capacity for flood mitigation needs and, ultimately, the size of the reservoir. See Alberta Transportation's response to Round 1 AEP IR268 for additional details.

Question 14

Supplemental Information Request 1, Question 62, Pages 2.97-2.98

Alberta Transportation states *these reductions will also have a positive effect on natural features (e.g., soils, vegetation, wildlife) downstream of the Project by the substantial reduction of adverse effects relative to flood without the Project: the Project will reduce the disturbance and/or destruction of riparian and adjoining areas along Elbow River, while still allowing flood flows of 160 m^3/s that will maintain river ecological functions.*

a. **Explain why reducing changes caused by flooding on natural ecological (e.g., scouring) and geomorphic (e.g., altering river dynamics and bedload transport) processes are considered positive in direction. It may be from an anthropogenic standpoint, but is less obvious from a natural/environmental stand point.**

b. **Describe and explain how 160 m^3/s was determined to be adequate to maintain river ecological functions.**

Response

This response will be included in a future filing.

Question 15

Supplemental Information Request 1, Question 67, Pages 2.101-2.102
Supplemental Information Request 1, Question 67, Figure IR67-1, Page 2.102

Alberta Transportation states *there is no comparable data set in which to do an independent validation and that the calibration shows the simulation reproduces the measured water levels in terms of the variation magnitudes and phases, except at the peak.*

If a model is calibrated using a given set of data and the model is subsequently run to simulate the same scenario (from which the numbers were used to calibrate the model, as done in Figure IR67-1), it is a given that the model will produce similar results.

a. If the model has not been validated, quantify the expected error range or uncertainty/confidence in modelled numbers for the scenarios run with the model. Also, provide the associated level of confidence for each.

Response

This response will be included in a future filing.

Question 16

Supplemental Information Request 1, Question 70, Page 2.107

Alberta Transportation states that *however, sediment related parameters are bound with sediment particles and will not be available for biological assimilation (Volume 3B, Section 7.4.6, page 7.20- 7.23). Only 1.8% of the sediments entering the reservoir (for a design flood) will be released from the reservoir….*

Some parameters may behave similar to sediment and/or be sediment related, that does not necessarily mean they are sediment bound and/or biologically unavailable. Any constituent still dissolved in water is available for biological assimilation (e.g., TDP).

a. Explain how all sediment related parameters are bound with sediment particles.

Response

This response will be included in a future filing.

Question 17

Supplemental Information Request 1, Question 83, Pages 2.127-2.129
Supplemental Information Request 1, Question 83, Figure IR83-1, Page 2.127
Supplemental Information Request 1, Question 101, Pages 2.175-2.177

Alberta Transportation provided a description of dissolved oxygen (DO) measurements and changes to water temperature.

a. Explain if there is a possibility for further decreases in DO concentration within the Elbow River during release of relatively warmer water from the reservoir and/or an increase in nutrient loading (and other sediment related parameters), given that summer DO concentrations are already relatively low at times.

b. Explain the effects to aquatic resources in the Elbow River due to changes in DO caused by reservoir water release during summer. Use the assumption that the existing aquatic biological community may already be stressed by low DO concentrations.

c. Quantify changes to reservoir water temperature and DO concentrations caused by differences (e.g., increases) in water retention periods.

d. Assess the effects of elevated water temperature on the health of fish and fish use of habitats for each indicator fish species and life stage.

Response

This response will be included in a future filing.

Question 18

Supplemental Information Request 1, Question 86, Page 2.139

Alberta Transportation concludes that *therefore, concentrations returning to Elbow River are predicted to be similar to when they entered the reservoir.*

a. Describe how nutrient concentrations in water released from the reservoir will compare to water in the Elbow River at the time of release (i.e., when flow is <20 m^3/s and relatively more clear), not at the time of diversion (i.e., during flood conditions).

b. Explain how differences in timing of nutrient release may affect the Elbow River.

c. Provide/quantify expected nutrient concentrations for released water.

Response

This response will be included in a future filing.

Question 19

Supplemental Information Request 1, Question 92, Page 2.146
Supplemental Information Request 1, Question 342, Page 5.225

Alberta Transportation states that the *assessment of aquatic ecology uses desktop and field analyses to evaluate Project-related effects, and the assessment relies on the Project data to address the Project- related effects using Fisheries and Oceans Canada's pathway of effects (DFO 2014) to indicate which Project activities will or may result in an effect*. In addition, Alberta Transportation also states that *surveys to generate quantitative population estimates of fishery resources were not conducted as part of the assessment*.

Baseline information that describes the species composition, distribution, abundance, movements, habitat use, habitat quality, and life history parameters of fish populations currently residing within the LAA are not presented. A general description of fish species ecology and habitat requirements provides limited information and a coarse understanding of the Elbow River fish ecology, making it difficult to evaluate potential project effects.

a. **Explain how the baseline information can be used to adequately describe species composition, distribution, abundance, movement, habitat use, habitat quality, and life history parameters of fish populations actually residing within the LAA and evaluate the potential project effects.**

b. **Demonstrate that data summaries generated by the desktop review and from data collected by the field program is of sufficient quality to reliably describe the LAA fish community structure (i.e., species composition) and the LAA species population characteristics (spatial distribution, relative abundance, movements, habitat use and life history). Include a discussion of the:**

   i. **Current relevance of FWMIS information to describe existing fish resources.**

   ii. **Field program specifics, including sampling methods and timing.**

c. **Demonstrate that the fish data presented is accurate and sufficient to meet requirements in the Terms of Reference Section 3.6.1 and to permit confident evaluation of project effects on LAA fish species populations.**

Response

This response will be included in a future filing.

Question 20

Supplemental Information Request 1, Question 95, Pages 2.150-2.154
Response to CEAA IR, Package 3, Response IR3-26a, Page 114

Alberta Transportation states that *fish passage criteria and abilities are presented in the response to IR91 (and further discussed in Appendix IR91-1, Table 1) and presented here as Table IR95-1, and that Figure IR95-1 demonstrates the ability for the noted species in Elbow River to move up and downstream of the service spillway and stilling basin.*

a. Justify the use of the Pike Group swimming performance curve given that it is based on a derived equation intended to represent Northern Pike.

b. Demonstrate the ability to pass burbot through the instream works under each of the flow scenarios (as presented in IR3-26) using swimming performance data for Eel Group.

c. Justify the use of a minimum water depth of 0.18 m over the gate bays as criteria for successful fish passage, addressing water depth requirements for the individual Elbow River fish species and fish sizes predicted to require passage.

   i. Include the time period, flow regime (discharge), and hydraulics of the passage structure that will occur when fish passage is required.

   ii. Identify limitations to fish passage for each fish species.

d. Provide a figure of sufficient scale to allow clear identification of preferred fish movement routes within the service spillway and the stilling basin.

Response

This response will be included in a future filing.

Question 21

Supplemental Information Request 1, Question 93, Pages 2.147 to 2.148
Response to CEAA IR, Package 3, Appendix IR26-1, Figure 1 and 2, Page 26-1.2

Alberta Transportation states in the SIR1 response that the *proposed engineered fish passage measures are designed to maintain sufficient depth for fish passage*. Alberta Transportation indicates in the CEAA IR response package that the fish swimming criteria used as a basis for fish passage structure design set minimum fish length at 250 mm.

a. **Demonstrate that all fish sizes and fish swimming abilities of species expected to require upstream passage have been incorporated into the design and operation of the fish passage mitigation structures, including an evaluation of effectiveness to pass small fish (≤ 150 mm length) during all flow scenarios.**

b. **Discuss limitations to the effectiveness of upstream fish passage caused by design criteria of ≥ 250 mm fish length. Include a discussion of upstream fish during higher than low flow conditions.**

c. **Discuss the expected life span of the mitigation measures in terms of structural stability and as-built specifications.**

Response

This response will be included in a future filing.

Question 22

Supplemental Information Request 1, Question 98, Pages 2.159-2.161

Alberta Transportation states *Backwater effects from flood operations are not expected to degrade existing habitat upstream of the diversion inlet, given that the area does not currently offer instream and nearshore habitat complexity. Reforming channel flows are likely to result in habitat of similar quality and fish migration is expected to be maintained.* Alberta Transportation also describes that *The backwater effect will primarily occur upstream of the service spillway and diversion intake forebay area (see additional explanation of the backwater effect in the response to IR73b). The service spillway and stilling basin are near bed grade and will promote preferential flow through the structures and downstream despite any backwater effect (i.e., are designed to accept flood flows without impeding bedload sediment transport). The deposition from the backwater effect in flood operations is, therefore, not expected to affect hydraulics in the stilling basin and will not result conditions that impede fish passage.*

a. **Demonstrate that the habitat assessment used as the basis for this statement quantified nearshore habitat complexity.**

b. **Demonstrate that sediment deposition upstream of the service spillway will not alter the channel gradient through the stilling basin fish passage structure.**

c. **Demonstrate that sediment deposition upstream of the service spillway will not cause sediment deposition in the stilling basin fish passage structure due to erosion of a new channel through the sediments deposited upstream of the service spillway.**

Response

This response will be included in a future filing.

Question 23

Supplemental Information Request 1, Question 99, Page 2.162

Alberta Transportation states that bed elevation differences less than 0.2 m accounts for 99.0% of the overall area. Therefore, the overall impact is not anticipated to result in morphological change in the river, and that a change less than 0.2 m on bar heads is considered a small change to habitat that is not detrimental to fish habitat.

Many species and life stages of fish populations that reside in the Elbow River utilize fish habitats defined by water depths less than 0.2 m (e.g., trout and mountain whitefish spawning areas, large-fish species rearing areas, and small-fish species habitat).

a. Provide further justification that changes in fish habitat less than 0.2 m, including areas with water depths of less than 0.2 m, will not be detrimental to fish species.

b. Assess the effects of changes in channel morphology on each indicator fish species at each life stage.

Response

This response will be included in a future filing.

Question 24

Supplemental Information Request 1, Question 100, Pages 2.166 to 2.175
Supplemental Information Request 1, Question 100, Table IR100-1, Page 2.167
Supplemental Information Request 1, Question 100, Table IR100-2, Page 2.171

Alberta Transportation provides Table IR100-1 and states that *release of sediment into the Elbow River when flows are less than 20 m^3/s could affect the quality of fish habitat in the Elbow River downstream of the confluence with the unnamed creek.*

a. Identify the effects, and evaluate the consequences, of a sediment release for a duration of 30 days comparing released water total suspended solids (TSS) to background Elbow River TSS concentrations.

Alberta Transportation provides Table IR100–2, which, as referenced, is not a risk evaluation based on a specific stress index metric.

b. Quantify the effects of predicted suspended sediment concentration on each indicator fish species and life stage using an accepted stress index metric.

c. Estimate the spatial extent of suspended sediment effect on the Elbow River fish habitat downstream of the diversion. Evaluate the effects of increased suspended sediment concentrations and the deposition of sediment on fish habitat for each indicator fish species at each life stage.

Response

This response will be included in a future filing.

Question 25

Supplemental Information Request 1, Question 102, Pages 2.178 to 2.180

Alberta Transportation provides discussion on identifying the potential sources of TGP and how the Project design provides mitigation in the unlikely event that TGP occurs.

Water entrainment depth, an important factor influencing total gas pressure (TGP), is not provided. TGP levels were not estimated for expected flood flows.

a. Evaluate the potential for elevated TGP levels using project design features identified in USACE (2002).

b. Provide an evaluation of the effect and extent of elevated TGP on indicator fish species populations (including habitat use and health) in the Elbow River. Base the evaluation on estimates of TGP levels for expected flood flows caused by differences between the spillway gate crest water elevation and stilling basin water elevation.

Response

This response will be included in a future filing.

Question 26

Supplemental Information Request 1, Question 104, Page 2.184

Alberta Transportation states that cumulative effects on aquatic ecology are not anticipated between the Project and Glenmore Dam and Glenmore Reservoir. Specifically, regarding potential pathways arising from direct Project effects, effects on water quality and fish mortality are not anticipated to interact with the Glenmore Dam and Glenmore Reservoir.

a. List the predicted residual project effects in the aquatics ecology LAA. Include indicators used for hydrogeology, hydrology, surface water quality, and aquatic ecology for project Construction, Dry-Operations, Flood, and Post-flood Operations.

b. Provide justification as to why a cumulative effects evaluation is not required where residual project effects are predicted.

c. Describe any cumulative effects of the Glenmore Dam and Reservoir operations on aquatic ecology.

Response

This response will be included in a future filing.

Question 27

Supplemental Information Request 1, Question 153, Page 3.29

Alberta Transportation states that *since March 2018, Alberta Transportation has also received a final TUS from the Blood Tribe/Kainai, and technical reviews of the EIA from the Blood Tribe/Kainai, Piikani Nation, and Tsuut'ina Nation. Alberta Transportation has provided responses to the issues and concerns raised, where possible, both at meetings and in writing, and explained the proposed mitigation measures. Written responses to the technical reviews provided by the First Nations are forthcoming. Further consultation is anticipated to ensure all issues and concerns are responded to.*

a. Provide the final Traditional Use Study (TUS) from the Blood Tribe/Kainai.

b. Provide the technical reviews of the EIA from the Blood Tribe/Kainai, Piikani Nation, and Tsuut'ina Nation, and any other First Nations or Aboriginal communities that have provided such reviews.

c. Provide Alberta Transportation's written responses to the technical reviews.

d. Confirm any TUS reports Alberta Transportation expects will be provided by other Treaty 7 First Nations and any other First Nations or Aboriginal communities required to be consulted.

Response

This response was included in the April 8, 2020 filing.

Question 28

Supplemental Information Request 1, Question 342, Page 5.227
Supplemental Information Request 1, Question 342, Table IR342-1, Page 5.226
Supplemental Information Request 1, Question 342, Table IR342-2, Page 5.227

Alberta Transportation presents new information in Tables IR342-1 and IR342-2 that quantifies the status of bull trout and westslope cutthroat trout populations and states that *population level fisheries data was not collected in the Elbow River*. There is an absence of information for fish species other than trout.

a. **Explain how the new data (Tables IR342-1 and IR342-2) was incorporated into the effects assessment.**

b. **Discuss how the variability and level of detail in information used for the population estimates, including the absence of population estimates for fish species other than trout, influences the reliability of the conclusions of the effects assessment.**

Response

This response will be included in a future filing.

Question 29

Supplemental Information Request 1, Question 346, Page 5.233

Alberta Transportation states that *large woody debris taken from the debris deflector, intake structure, and gates will be removed from the beds and shores and will not be reintroduced downstream in the river*.

a. **Quantify the amount of woody debris that will be removed from the system downstream of the project relative to the total amount that would be available without the project.**

b. **Evaluate how the loss of woody debris recruitment to the lower Elbow River will affect fish habitat and aquatic productivity.**

Response

This response will be included in a future filing.

Question 30

Supplemental Information Request 1, Question 348, Page 5.235

Alberta Transportation states *suspended sediment concentrations in the water from the off-stream reservoir is predicted to increase during the last few days and that without mitigation the resulting increase in the Elbow River of suspended sediment concentrations is likely to exceed the Canadian Water Quality Guideline*.

a. Delineate and quantify the downstream extent of total suspended solid (TSS) concentrations that exceed water quality guidelines for the protection of aquatic life for the 1:10 and 1:100 flood events.

b. Provide an evaluation of impacts downstream from the release of turbid water over an extended period of time for fish survival, fish habitat, and aquatic productivity. The severity of ill effects dose-response curve can be used to evaluate impacts on fish survival.

c. Provide estimated frequency of flood water release during the period of September 01 to October 31 for the 1:10 and 1:100 year flood event.

d. Describe where and when Elbow River mountain whitefish and brown trout populations spawn in the Elbow River downstream of the outlet structure.

e. Evaluate effects of elevated suspended sediment levels and increased duration of elevated suspended sediment concentrations on species populations (i.e., mountain whitefish and brown trout) potentially using the portion of the Elbow River below the outlet structure for spawning during post-flood reservoir draining.

Response

This response will be included in a future filing.

Question 31

Supplemental Information Request 1, Question 350, Pages 5.245-5.247

Alberta Transportation states that *the potential for 80% of fish being displaced is considered conservative and high, that the relationship between fish displaced and percent of flow is likely less than 1:1, and that development of a new model would not reduce uncertainty in the assessment.*

a. Outline mitigation measures and monitoring programs to be implemented to ensure survival of fish entrained into the diversion channel, excluding efforts associated with fish rescue.

Response

This response will be included in a future filing.

Question 32

Supplemental Information Request 1, Question 351, Page 5.248

Alberta Transportation states that *areas within the reservoir will be graded to provide positive drainage and reduce stranding of fish during release of stored flood water from the reservoir* and that a fish monitoring program and rescue plan will mitigate impacts caused by fish entrainment.

a. **Provide examples of, and discuss, the effectiveness of fish rescue operations in large impoundments dominated by silt substrates and those that are subjected to rapid dewatering.**

b. **Quantify the likelihood of survival of fish trapped within the reservoir that are subjected to predicted TSS concentrations for the duration of the water retention period using the severity of ill effects dose-response curve.**

Response

This response will be included in a future filing.

Question 33

Supplemental Information Request 1, Question 353, Page 5.257

Alberta Transportation states that *conditions and engineering criteria for fish passage are well understood and are incorporated into the service spillway structure design* and that *thresholds for water level, as indicated by the pressure transducer, will indicate when volumes of water over the diversion gates and v-weirs are inadequate for fish passage and gate operations are required.*

a. **Justify and explain how a good understanding of conditions and engineering criteria for fish passage will ensure, with certainty, upstream and downstream fish passage of all Elbow River fish species at all life stages under all flow conditions.**

b. **Describe if a monitoring program that quantifies actual fish passage is proposed. If no monitoring program that quantifies actual fish passage is proposed then explain why not.**

Response

This response will be included in a future filing.

Question 34

Supplemental Information Request 1, Question 357, Pages 5.279 to 5.280

Alberta Transportation states that *bull trout are not expected to spawn in the portion of the Elbow River that is in the PDA or downstream of the of the PDA; however, they may migrate upstream through the PDA to upstream spawning locations and downstream after spawning, but this is not confirmed* [Page 5.279] and that *[m]uch of Elbow River, from the Elbow River falls to Glenmore reservoir, could be used for migration during various life history stages*.

a. **Map and describe fish habitat areas (i.e., physical locations, including ecologically important areas) used by bull trout populations in the Elbow River. Include spawning, nursery, rearing, food supply and migration areas, on which the bull trout population depends.**

b. **Summarize data gaps in bull trout fish habitat information (including spawning, nursery, rearing, and food supply), migration areas and the presence of known ecologically important areas. Evaluate how these data gaps influence the effects assessment.**

c. **Map and describe existing fish habitat areas including mountain whitefish. Include ecologically important areas, used by each of the fish species populations identified in Response 357b. Include spawning, nursery, rearing, food supply and migration areas, on which each population depends directly or indirectly in order to carry out their life processes.**

d. **Summarize data gaps in fish habitat information used by each fish species population identified in Response 357b including spawning, nursery, rearing, food supply and migration areas, and evaluate how these data gaps influence the effects assessment.**

Response

This response will be included in a future filing.

Question 35

Supplemental Information Request 1, Question 415, Page 6.134

Alberta Transportation states the *Enforcement Occurrence Record (ENFOR) data were not used in this assessment because the majority of records do not provide spatial locations of animal occurrences and can only be extracted using broad geographic areas (e.g., wildlife management units (WMU)), which extend beyond the wildlife LAA and wildlife RAA* and that *with the potential for there to be managed access to the PDA, human-grizzly bear conflict and conflicts with other wildlife species could increase; however, the frequency of grizzly bear use is expected to be low based on the information presented in Volume 3A, Section 11.2.2.2, page 11.28, which indicates the wildlife LAA provides relatively low suitability habitat. In addition to the mitigation commitments in Volume 3B, Section 11, Alberta Transportation (and AEP for*

operations) will implement beneficial management practices designed to reduce potential increase in human-wildlife conflict (e.g., signage, safety, education).

a. Describe how discrepancies between AEPs and Alberta Transportations information on grizzly bear use of the project area changes conclusions on impacts to grizzly bears (e.g., human-bear conflict, mortality, etc.).

b. Detail a plan to proactively reduce human-bear interactions and how these will be minimized and monitored.

Response

a. During a call on December 19, 2019 with AEP and NRCB, the NRCB expressed an interest in what data sources were used for the assessment. The wildlife assessment included a brief discussion of grizzly bear movement based on a small sample of telemetry information provided by AEP, but it did not provide a detailed assessment of grizzly bear movement in the LAA. Alberta Transportation received personal communication on February 6, 2020 from AEP indicating that the data sources used in the assessment were appropriate (Jurijew 2020, pers. comm). Based on this clarification, Alberta Transportation understands that there is no discrepancy between AEP and Alberta Transportation's information on grizzly bear use of the Project area.

   As part of the literature review and field surveys undertaken for the preparation of the grizzly bear assessment, it was confirmed that grizzly bears have used both the LAA and RAA. Specifically, potential effects of the Project on grizzly bear habitat, movement and mortality risk were based on the following available sources of information:

   - scientific literature (see the EIA, Volume 4, Appendix H, Section 11A.2.5) and other literature cited in Volume 3A, Section 11
   - Draft Alberta Grizzly Bear Recovery Plan (AEP 2016)
   - Alberta Fisheries and Wildlife Management Information System (FWMIS)
   - Alberta Wildlife Sensitivity Data (grizzly bear core and secondary recovery zones)
   - Eastern Slopes Grizzly Bear Project (Herrero 2005)
   - Wildlife Habitat Assessment Jumpingpound Pipeline Region (Collister and Kansas 1997)
   - Highway 22:14 and 22:16 Highway Twinning and Interchange Reconfiguration Environmental Overview Assessment (EBA 2010)
   - Bear Hazard Assessment Update for the Greater Bragg Creek Area of Southern Alberta (Jorgenson 2016)
   - Stoney Nakoda Nations Cultural Assessment for enhancing grizzly bear management programs through the inclusion of cultural monitoring and traditional ecological knowledge (Stoney Consultation Team 2016)

- grizzly bear telemetry data provided by AEP (Paczkowski 2016 and Stenhouse 2016 pers. comm), which is discussed in Volume 3A Section 11.2.2.5 (Wildlife Observations)
- remote camera survey results (see Volume 4, Appendix H, Section 3.6)

Alberta Transportation's response to Round 1 AEP IR415 suggested that historical sightings and occurrences in the Enforcement Occurrence Records (ENFOR) database indicate grizzly bear use is known to be greater than reported wildlife assessment in the EIA. However, the ENFOR database provided to Alberta Transportation by AEP did not include bear-human conflicts other than animal-vehicle collisions. AEP has since confirmed that no additional bear-human conflict information is available in the ENFOR database for the Project area (Jurijew 2020, pers. comm).

Given that the ENFOR database did not include additional data on bear-human conflicts, the data sources listed above are appropriate to inform the change in mortality risk associated with the Project.

b. Mitigation to reduce potential human-bear interactions during construction and dry operation is described in Volume 3A, Section 11.4.4.2 as well as in the draft Wildlife Mitigation and Monitoring Plan (WMMP) (see Alberta Transportation's response to Round 1 AEP IR425, Appendix IR425-1) including:

- Waste will be stored in wildlife-proof containers and wildlife awareness training will be provided to staff on site to reduce human-wildlife conflict (e.g., bears, see Jorgenson 2016).
- Personnel will not be permitted to have dogs at the construction site. Firearms are not permitted in project vehicles or on the construction footprint, or at associated project facilities. Incidents with wildlife will be reported to an Alberta Transportation representative.
- Sightings of species of interest will be reported to the environmental inspector(s) or designate. Protection measures might be implemented, and the sighting will be recorded.
- If previously unidentified listed or sensitive wildlife species or their site-specific habitat (e.g., dens, nests) are identified during construction, then the occurrence will be reported to the environmental inspector(s) or designate.
- Unanticipated wildlife issues encountered during construction will be discussed and resolved by the environmental inspector(s) or designate, wildlife resource specialist(s), and the responsible regulatory agencies, if necessary.
- Unauthorized vehicles will be prevented from access from public roads by using gates.

For further clarification, if a bear-human interaction occurs, the incident would be reported to the Environmental Inspector and AEP (Fish and Wildlife).

The mitigation proposed to reduce potential Project effects on grizzly bears aligns with best management practices designed to reduce mortality risk to grizzly bears (e.g., Alberta Bear Smart Program) (GOA 2011), including the overriding objective to reduce attractants within the Grizzly Bear Recovery Support Zone (AEP 2016). Further details related to mitigation to reduce human-bear conflict will be provided in the final WMMP, which will be prepared in consultation with provincial and federal regulators as well Indigenous groups.

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Stenhouse, G. 2016. Wildlife Carnivore Biologist, Foothills Research Institute. Personal communication, email.

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Question 36

Supplemental Information Request 1, Question 425, Page 6.147
Supplemental Information Request 1, Appendix IR425-1, Pages 1.1 to 9.2

Alberta Transportation states a *draft wildlife mitigation and monitoring plan…in Appendix IR425-1. The final plan will be developed following Project approval and based on provincial and federal approval conditions.*

a. **Provide details on what would be included within biodiversity monitoring plans for birds and amphibians in the monitoring program (which may consider the use of bioacoustics).**

b. **Describe specifics on how comparisons and assessments were completed for bird and amphibian species richness between baseline, construction and dry operation, flood and post-flood operations, and how these will be incorporated into the mitigation and monitoring plan.**

Response

a. During a call on December 19, 2019 with AEP and NRCB, AEP clarified that this question is referring to the WMMP. Alberta Transportation also clarified that mitigation for birds and amphibians will be included in the WMMP. On-site monitoring for birds and amphibians during construction will be implemented where required; for example, for active raptor nests in the area and for amphibians that would need to be moved out of harm's way if they occurred within the fenced construction footprint.

b. Migratory birds and amphibians (e.g., northern leopard frog) are assessed for all Project phases relative to existing conditions (see the EIA, Volume 3A, Section 11.4 and Volume 3B, Section 11.3). Estimates of bird species richness are provided in Volume 4, Appendix H, Table 3-1 and, for amphibians, in Volume 4, Appendix H, Section 3.2, Table 3-3 and Table 3-4. The wildlife assessment uses a habitat-based approach that quantifies how much bird or wetland habitat is affected during each Project phase and then relates that habitat type to the birds or amphibians known to use it based on habitat associations. Although the Project will result in the loss and alteration of bird and amphibian habitat, bird and amphibian species richness (i.e., the number of bird and amphibian species in the LAA) is not expected to change because there will be other suitable habitats available within the LAA and RAA. If any amphibian or bird species at risk are identified during pre-construction wildlife surveys, post-construction monitoring during dry operations will be considered as part of the final WMMP, which will be completed in discussions with regulators and in consultation with Indigenous groups.

   As stated in the response to a., bird and amphibian mitigation monitoring will be completed during construction, as described in the WMMP. In addition, a habitat-based assessment will be conducted during post-flood operations, which will include potential post-flood effects on amphibians and birds, as described in Section 7.2.1 of the draft WMMP (see Alberta

Transportation's response to Round 1 AEP IR425, Appendix IR425-1). Specifically, the post-flood habitat assessment would be completed following complete release of water from the off-stream reservoir. The assessment will be completed at least twice: 1) immediately following the draining of the reservoir when it is safe to enter the reservoir and 2) an assessment completed the following spring. The assessment will evaluate the status of revegetation and change in habitat suitability for key wildlife indicators and species of management concern, with a focus on wetland-dependent species and ground-nesting birds.

Question 37

Supplemental Information Request 1, Question 428, Pages 6.153 to 6.155
Supplemental Information Request 1, Appendix IR425-1, Pages 1.1 to 9.2

Alberta Transportation states that *remote cameras are a common tool used to determine potential effects of human development on wildlife as well as to evaluate the effectiveness of mitigation measures (McCollister and van Manen 2010; Barrueto et al. 2014; Burton et al. 2015; Andis et al. 2017; Caravaggi et al. 2017). The purpose of the remote camera monitoring program (as part of the draft wildlife mitigation and monitoring plan; see Appendix IR425-1) is to verify predictions related to residual effects of the Project on wildlife movement in the wildlife LAA, particularly for ungulates such as deer and elk.*

a. **Describe how remote camera data could provide quantitative information on wildlife movement to support impact predictions.**

b. **Clarify how data from remote cameras will be used to test wildlife impact predictions (e.g., detail the relationship between camera trap detection and the ecological parameter of interest, such as habitat use and movement).**

c. **Demonstrate that baseline camera data is sufficient to detect changes in habitat use and movement in follow-up and monitoring programs.**

Response

a. The remote camera data will provide photographs of species occurrence (e.g., elk) and behavioural response at specific locations along the diversion channel. Behavioural responses will be classified as the following: approaches, successful crossings, and deflections (Simpson et al. 2016). The crossing success rate (%) will be calculated by dividing the number of successful crossings by the total number of approaches at each location along the diversion channel (Simpson et al. 2016; Sawyer et al. 2012). The same metric will be used as the performance measure to assess mitigation effectiveness for the Highway 22 bridge over the diversion channel and at select locations of wildlife-friendly fencing. Crossing success rate targets (% crossing) will be identified in the final WMMP.

As discussed, Section 7.1.12 of the draft WMMP (see Alberta Transportation's response to Round 1 AEP IR425, Appendix IR425-1), limitations related to study design, including sample size (i.e., number of cameras), camera placement, timing, frequency and duration of the monitoring program will be identified following consultations with regulators and Indigenous groups and discussed in the final WMMP.

b. As discussed in Section 1.1 and 7.0 of the draft WMMP, the remote camera monitoring program will be designed to evaluate the effectiveness of proposed mitigation in reducing potential Project effects on wildlife movement, which is accounted for in the residual effect prediction for change in wildlife movement. The specific metrics used to assess wildlife movement in the LAA during construction and dry operations—discussed in the draft WMMP (see Section 7.1.14) and the response to Round 1 AEP IR428—will include a relative abundance index such as photographic rate (i.e., number of detections per 100 camera-days) and crossing success rate defined in a. of this response. The number of detections at each camera location during construction and dry operations will be compared to baseline detection rates for target species as a way to evaluate change in seasonal habitat use (e.g., along Elbow River, east and west of Highway 22, north of Township Road 244 and along Springbank Road).

c. Although the remote camera monitoring program will provide quantitative information related to mitigation effectiveness (i.e., crossing success at various Project component structures), the ability to detect changes in animal abundance in the LAA might be limited because of the short, four-season duration of the baseline remote camera survey that was completed for the Project and reported on in the EIA wildlife assessment. However, based on those results, which included 3,207 camera-days of survey effort captured over four seasons, some of the target wildlife species are relatively abundant in the LAA, such as white-tailed deer, mule deer and elk (see EIA, Volume 4, Appendix H, Section 3.6.1). Based on the 10 cameras deployed, estimates of detected occupancy rates (proportion of sites that recorded at least one photograph) across all seasons was 100%, 80% and 80% for white-tailed deer, mule deer and elk, respectively.

   Species that are relatively common and have moderate or high detectability compared to rare species typically require fewer cameras and shorter sampling periods (i.e., survey effort) to provide reliable estimates of animal occupancy (Shannon et al. 2014).

   The remote camera monitoring program, which will include deployment of additional cameras, will reliably detect focal wildlife species habitat use and activity for species known to be relatively abundant in the LAA (i.e., ungulates).

   Consultation with regulators and input from Indigenous groups regarding design of the remote camera monitoring program will provide the necessary information to identify limitations of the study design and effectively evaluate mitigation proposed to facilitate wildlife movement in the LAA.

References

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Question 38

Supplemental Information Request 1, Question 447, Page 7.42
Volume 3A, Section 15.7, Page 15.65

Alberta Transportation discusses the exposure ratio (ER) for short term exposures to $PM_{2.5}$ and diesel exhaust particulate (DEP). A discussion on chronic effects to the residential receptor (SR19) is not provided, which has an exposure ratio greater than 1.

a. Discuss $PM_{2.5}$ (chronic) risk results for residential receptor SR19 in the conclusion section of the Public Health Report (Volume 3A, Section 15.7), or provide rational for its exclusion.

Response

a. The calculated exposure ratio (ER) is greater than 1.0 for chronic exposures to $PM_{2.5}$ at sensitive receptor location 19 (SR19) during the 36-month construction phase; however, an ER greater than 1.0 does not necessarily indicate that adverse health effects are expected to occur, nor are the health risks considered unacceptable (GoA 2011). Rather, in these situations further considerations are needed to assess the nature and likelihood of potential adverse human health effects, such as spatial extent of exceedance, magnitude of exceedance, potential mitigation measures, and uncertainties in toxicity. When these factors are considered, the following is noted:

- SR19 (the only sensitive receptor location with an exceedance of the chronic ER for $PM_{2.5}$) is located approximately 53 m from the boundary of the PDA and roadways (i.e., limited spatial extent relative to the human health risk assessment [HHRA] LAA).
- The ER at SR19 for construction is 1.3, based on a predicted annual average concentration of $PM_{2.5}$ of 13 μg/m^3 and a chronic exposure limit of 10 μg/m^3.

- The source of $PM_{2.5}$ at SR19 is primarily fugitive dust from soil. Fugitive dust emissions can be effectively mitigated using industry best practice mitigation measures, such as frequent road watering or application of dust suppressants. The construction schedule may also be adjusted to reduce the number of dust-generating vehicles operating in an area during dry periods with high wind conditions. Although standard dust suppression measures were considered as part of the modelling, adaptive management will be used to adjust the types and intensity of mitigation. Real-time $PM_{2.5}$ monitors will be deployed in the areas of concern to indicate when these more intensive dust mitigation measures may be needed. The construction contractor, as per the Construction Works Master Specifications Environmental Section 01391 (see EIA, Volume 4, Supporting Documentation, Document 11), will implement an ambient air monitoring program during construction that will include continuous monitoring of $PM_{2.5}$. The use of real-time monitoring results to trigger more intensive dust mitigation measures is expected to maintain annual $PM_{2.5}$ concentrations below the exposure limit of 10 µg/m^3 at SR19.
- Epidemiological studies, which rely on ambient air monitoring systems to estimate population average exposure, provide evidence of both cardiovascular and respiratory health effects from chronic exposure to $PM_{2.5}$, although the risks for PM-related health effects are relatively small by traditional epidemiological standards (Health Canada 2013).
- Both Health Canada (2016) and the World Health Organization (WHO 2006) noted a number of studies that suggest particulate from inert crustal material (i.e., dust from soil) is less toxic than particulate associated with urban environments, upon which the chronic exposure limit is based. This suggests that the exposure limit of 10 µg/m^3 may be overly conservative (an overestimate) for exposure to $PM_{2.5}$ from fugitive dust, which is the primary source of $PM_{2.5}$ at SR19.

As noted in Volume 3A, Section 3.4.3.3, the air emissions associated with Project construction are typical for a construction site that involves surface disturbances and associated earth moving activities. The primary source of annual $PM_{2.5}$ concentrations is dust from soil. the spatial extent of concentrations that are greater than this exposure limit is minimal. Real-time $PM_{2.5}$ monitors will be used to identify the need for more intensive dust mitigation measures to prevent elevated exposures. As a result, the Project is not expected to result in an unacceptable chronic risk to human health. This supports the original conclusion in the conclusion section on Public Health (Volume 3A, Section 15) which states, in part, that the effects from air quality are not significant for the construction and dry operations phases.

REFERENCES

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Question 39

Response to CEAA IR, Package 3, Response IR3-32a, Page 130

Alberta Transportation provided quantitative risk estimates for hexavalent chromium and trivalent chromium to provide estimates of risk associated with anticipated airborne exposure during the construction phase.

a. Clarify whether life-time exposure or a three-year construction exposure were used in the above risk estimate.

Response

a. The chronic risk estimates are conservatively based (exposures are overestimated) on life-time exposure. The annual average concentrations are compared directly to the chronic toxicological reference value (TRV) (i.e., no amortization of exposures was used). This means that the health risk assessment assumes people will be exposed to hexavalent chromium emissions from construction for approximately 80 years, whereas the construction period is actually three years.

2 GENERAL

2.1 SOCIO-ECONOMIC

Question 40

Supplemental Information Request 1, Question 165, Page 3.57
Supplemental Information Request 1, Question 179, Page 3.75
Supplemental Information Request 1, Question 181, Page 3.79

In question 181 Alberta Transportation states *the types of measures that fail as the intensity of the flood increases include lower dykes (less that 1:50 year), flood outfall gates and temporary barriers.*

In question 165 Alberta Transportation states *AMEC (2014) recommended that assessments of SR1 and MC1 Option be progressed until such time that one becomes preferred*.

In question 179 Alberta Transportation states *RFDAM provides an estimate of flood damage for 12 return periods and allows for the computation of annual damage. It is predicated on myriad of qualified assumptions, and no uncertainty factor is applied to the values*.

a. Indicate if the following probabilities and their values were estimated: the probability of the structure failing

i. to work at all;

ii. to work partially;

iii. in a controlled manner;

iv. in an uncontrolled manner.

b. Indicate if these probabilities and values are factored into the cost benefit analysis and if so how they impacted the cost benefit analysis. If they were not factored into the cost benefit analysis, explain why they were excluded.

c. If the probabilities were deemed to be zero in the cost benefit analysis, provide the evidence and explain the procedures undertaken to assure the structure's design will work as intended. For example, reviews of similar weirs, assessments of contractors with expertise to construct these weirs, potential of conditions/events when the weir will not work properly, feasibility assurance mechanisms in the project's identification and design, and post-construction testing procedures that will assure the weir will work properly after it is constructed.

d. Identify events that will delay the successful construction and operationalizing of this non-conventional structure working and therefore delay of benefits in the cost benefit cash flow. Evaluate the probability and length of the delay. Estimate the impact on the cost benefit analysis.

e. The SIR response refers to the McLean Creek project in the cost benefit analysis. Assess whether the McLean Creek project might have similar probabilities of failure and/or delay in consideration of its more conventional dam and spillway design.

f. Provide an assessment of whether the factors (a) through (e) impact the relative merits of the Springbank Project in the cost benefit analysis.

Response

This response will be included in a future filing.

Question 41

Supplemental Information Request 1, Question 184, Page 3.84

Alberta Transportation states *Flood damage estimation and benefit/cost analysis methodologies associated with flood damage reduction studies are well-established in literature and have been recently formalized by virtue of the Government of Canada's publication: Canadian Guidelines and Database of Flood Vulnerability Functions, Public Safety Canada, March 2017, authored by IBI Group*.

a. Confirm that Public Safety Canada / Federal Government did not publish the document *Canadian Guidelines and Database for Flood Vulnerability and Database of Flood Vulnerability Functions (March 2017)*. Correct the SIR response to indicate that the publication has not yet been released.

b. Confirm that Natural Resources Canada is undertaking a review and edit of this document before its potential release.

Response

This response will be included in a future filing.

Question 42

Supplemental Information Request 1, Question 194, Pages 3.93 and 3.94

Alberta Transportation indicates that the costs associated with relocating the pipelines are covered by the project and included in the cost-benefit analysis. They also indicate that the companies will absorb the loss of income due to disruption in the pipeline flow during relocation.

Loss of income by the companies who own and operate the pipelines is technically a societal cost for the purpose of the cost-benefit analysis.

a. **Calculate the loss of income imposed to the companies who own and/or operate the pipelines to be relocated. Add this loss of income to the costs in the cost-benefit analysis. How has the cost-benefit analysis changed? Explain.**

Response

This response will be included in a future filing.

Question 43

Supplemental Information Request 1, Question 196, Page 3.95

Alberta Transportation indicates that the costs associated with relocating utilities are covered by the project and included in the cost-benefit analysis. Alberta Transportation goes on to indicate that utility companies will absorb the loss of income due to disruption of infrastructure services.

Loss of income by the utility companies is technically a societal cost for the purpose of the cost-benefit analysis.

a. **Calculate the loss of income imposed to utility companies whose infrastructure would have to be relocated. Add this loss of income to the costs in the cost-benefit analysis. How has the cost-benefit analysis changed?**

Response

This response will be included in a future filing.

Question 44

Supplemental Information Request 1, Question 197, Page 3.96
Supplemental Information Request 1, Appendix IR17-1, Table 17-25, Page 17.36

Alberta Transportation indicates that Table 17-25 in Appendix IR17-1 lists the Project costs that are estimated to be procured in the LAA, and that information is aggregated by major cost category, not by sub-components. The proponent also states *The cost of traffic accommodation (including traffic detours, land closures, etc.) is embodied in the information provided in Table 17-25, including the following cost items: "construction services" and "engineering services". The updated Table 17-25 is based on the current cost estimate ($312.2 million, exclusive of land cost)*.

a. The proponent did not clarify if these costs were included in the cost-benefit analysis. Clarify if the costs associated with traffic detours during construction, road realignments, and modifications were included in the cost-benefit analysis. If these costs were not included in the cost-benefit analysis explain why they were excluded.

b. The total costs included in Table 17-25 add up to $224 million, but the cost quoted by the proponent in their response is $312.2 million. Clarify what is the correct value of the current cost estimate. Correct the table or the response so that the correct value is indicated.

Response

This response will be included in a future filing.

3 AIR

3.1 AIR QUALITY ASSESSMENT

Question 45

Supplemental Information Request 1, Question 209, Page 4.9

The following observations regarding the rationale that odours will not be generated are:

- **A comparison of the Springbank Reservoir to the Glenmore Reservoir is not reasonable given that the Glenmore Reservoir will have a constant inflow and outflow whereas the Springbank Reservoir will be stagnant for many weeks during the warmest time of the year.**
- **There is no guarantee that wind action will occur at sufficient velocity to stir the reservoir. If a wind action occurs late in the detention time there is the potential to destabilize stratification such that odours are released. There are several examples of this phenomenon in Alberta reservoirs (some are called lakes) as follows:**

  i. Henderson Lake in Alberta;
  ii. Sunshine Lake in Okotoks;
  iii. Jesse Lake in Bonnyville; and
  iv. Bridlewood in Calgary.

a. Respond to the original question. What measures would be considered to mitigate air quality if anaerobic or anoxic conditions occurred?

Response

This response will be included in a future filing.

Question 46

Supplemental Information Request 1, Question 210a, Page 4.11

Alberta Transportation states the current speed limit on Highway 22 is 80 km/hour which is incorrect. The current speed limit on the segment of Highway 22 (between the Highway 8 and Highway 1 intersections) is 100 km/hour.

a. Update the SIR response using the correct and current Highway 22 speed limit of 100 km/hour.

Response

a. The response to Round 1 AEP IR210a is revised below for the current Highway 22 speed limit of 100 km/h and the current 24-hour AAAQO for $PM_{2.5}$ of 29 µg/m³ (AEP 2019); revised text is in **red**. The change in assumed speed limit does not change the conclusion of the response.

   Vehicles traveling through the project development area (PDA) on Highway 22 and Springbank Road will be in the PDA for only a few minutes and exposure of the passengers to particulate matter less than 2.5 micrometres in diameter is short term. In particular, the following describes the presence of the public in the PDA during construction:

   - The current speed limit on Highway 22 is **100 km/h**, but this will be reduced to 60 km/h on a segment of Highway 22 along the bridge construction area for raising of Highway 22. Considering the segment of Highway 22 between the intersection with Highway 8 and the bridge construction area (approximately 4 km), the time a vehicle travels along this segment will be approximately **2.4 minutes** (4 km/**100 km**/h x 60 min/h) when travelling at **100 km/hr**. At a speed limit of 60 km/h along the bridge construction area on Highway 22 (approximately 3 km), the time a vehicle travels along this segment would be 3 minutes (3 km/60 km/h x 60 min/h). In total, the travel time along Highway 22 will be approximately **5.4 minutes**.
   - The speed limit on Springbank Road is 80 km/h and, at this speed, the travel time through the PDA is about 4.5 minutes (6 km/80 km/h x 60 min/h).

   The predicted maximum 1-hour $PM_{2.5}$, 24-hour $PM_{2.5}$ and total suspended particles (TSP) concentrations for the Application Case along the sections of Highway 22 and Springbank Road that intersect the PDA are presented in Table 46-1. The maximum predicted concentrations along the road sections are greater than the Alberta ambient air quality objectives (Alberta Ambient Air Quality Objectives [AAAQO]; [**AEP 2019**]) for 24-hour average $PM_{2.5}$ **(29 µg/m³)** and TSP (100 µg/m³), and greater than the Alberta ambient air quality guideline (Alberta Ambient Air Quality Guidelines [AAAQG]; [**AEP 2019**]) for 1-hour average $PM_{2.5}$ concentrations (80 µg/m³). Elevated total suspended particulate (TSP) and $PM_{2.5}$ concentrations will be addressed through ambient air monitoring and adaptive management.

Table 46-1 Maximum Predicted Concentrations along Sections of Highway 22 and Springbank Road that Intersect the PDA (Application Case), Revision to Round 1 AEP IR210, Table IR210-1

Substance	Averaging Period	Maximum Predicted Concentration (µg/m³)		AAAQO/G (µg/m³)
		Highway 22	Springbank Road	
TSP	24-hour	200 to 400	350 to 500	100
$PM_{2.5}$	1-hour	120 to 200	70 to 90	80
$PM_{2.5}$	24-hour	60 to 100	30 to 40	**29**

This ends the revision of the Round 1 AEP IR210 response.

References

AEP (Alberta Environment and Parks). 2019. Alberta Ambient Air Quality Objectives and Guidelines Summary. January 2019.. Available at: https://open.alberta.ca/dataset/0d2ad470-117e-410f-ba4f-aa352cb02d4d/resource/4ddd8097-6787-43f3-bb4a-908e20f5e8f1/download/aaqo-summary-jan2019.pdf. Accessed: January 2020.

4 WATER

4.1 HYDROGEOLOGY

Question 47

Supplemental Information Request 1, Question 216, Page 5.8 – 5.9

Alberta Transportation states *a. Poroelastic response of an aquifer "loading effect" is generally limited to cases where the aquifer is fully confined over a wide area. By contrast, the groundwater regime in the RAA is characterized as an unconfined to semi-confined system, as is discussed in Section 3.2 of the Hydrogeology TDR Update (see the response to IR42, Appendix IR42-1). While some localized subsurface pressure response is expected near the Project components, regional scale poroelastic response within the bedrock aquifer is not expected to occur due to a lack of regional scale confinement.*

b. A regionally mappable clay layer does not exist underneath the fluvial deposits of the Elbow River. In general, the fluvial deposits of the Elbow River directly overlie bedrock.

c. Potential changes in groundwater levels are assessed by the numerical groundwater model, as described in the Hydrogeology TDR Update. However, changes in groundwater levels within the bedrock are not expected to be caused by poroelastic response because the bedrock is not regionally confined.

d-e. A draft groundwater monitoring plan for changes in groundwater levels is presented in the response to IR46, Appendix IR46-1. While poroelastic pressure response in the bedrock is not anticipated, monitoring of bedrock is included as part of the draft groundwater monitoring plan.

The most dangerous area of the potential loading effect is in the low topography area to the East and South-east of the off-stream dam. It is very likely the groundwater is under a confined condition due to its location in the relative low land area, especially when it is under the condition of a flood.

The potential loading effect is not related to the whole RAA with an area of approximately 43,050 ha. The groundwater as a whole maybe in the conditions of unconfined or semi-confined, but for the site specific issues, groundwater is very likely in the confined condition. Therefore, the potential loading effects to the East and South-East of the off-stream dam are valid.

From the East half of the off-stream reservoir to the East boundary of the RAA, the bedrock underneath is the Paskapoo formation (figure 3-4, Appendix IR42-1).In the western plains of Alberta the Paskapoo is characterized by buff-weathering, light grey to greenish thick bedded, calcareous quartz/chert sandstone, with interbedded light grey to greenish or brownish, soft, calcareous, sandy siltstone (Williams and Dyer, 1930; Allan and Sanderson, 1945; Glass, 1990). It

contains significant hydrogeological resources which are currently being exploited for agricultural, municipal and industrial uses.

The geological and hydrogeological characteristics of the Paskapoo formation support the potential groundwater pressure connection between the off-stream reservoir to the East and South-East of the off-stream dam through the loading effect when the reservoir is in use.

a. **Simulate the loading effect of the Springbank Off-Stream Reservoir on the confined aquifer to the East and South-East low topography areas of the off-stream dam.**

b. **Predict the potential artesian areas under the loading conditions in the area to the East and South-East of the low topography areas of the off-stream dam.**

c. **Assess the environmental impact of the loading effect.**

d. **Propose a monitoring plan for the loading effect and explain how this plan was derived.**

e. **Design a mitigation plan for the loading effect.**

f. **If Alberta Transportation decides not to do the analysis based on the same unconfined/semi-confined condition in the RAA, provide the contingency plan to deal with the potential groundwater "gush out" to the East and South-East of the off-stream dam should this occur.**

Response

This response will be included in a future filing.

Question 48

Supplemental Information Request 1, Question 217, Page 5.9 – 5.13
Supplemental Information Request 1, Appendix IR42-1, Figure 5-7, Page 5.13
Supplemental Information Request 1, Appendix IR42-1, Figure 5-9, Page 5.16

Figure 5-7 in Appendix IR42-1 is the Simulated Net Change in Head for the PPX0/EEX0 Scenario. There is positive drawdown (white area) along the edge of the diversion channel (the channel). The water level is higher along the edge of the channel (Figure 5-9 in the Appendix IR42-1) than the water levels further away from the channel, which will prohibit the discharge of the groundwater to the channel.

a. **These anomalies will underestimate the groundwater seepage to the channel.**

    i. **Are these anomalies related to geological change or are they related to grid size change? Explain.**

ii. Provide the updated seepage number after the anomaly problems are fixed. Explain this number.

iii. Provide an analysis of the size of the impact the anomalies have on the groundwater seepage estimation to the channel.

b. Provide groundwater flow directions on Figure 5-7 of Appendix IR42-1 to confirm if the local groundwater flow directions are towards the channel.

Response

This response will be included in a future filing.

Question 49

Supplemental Information Request 1, Question 230, Page 5.27 – 5.28
Supplemental Information Request 1, Appendix IR42-1, Figure 3-20, Page 3.41

Alberta Transportation states *a. The bedrock varies from unconfined to semi-confined to confined across the groundwater RAA …*

The site specific issue such as the loading effects to the East and South-East of the off-stream dam is not relevant to the whole RAA with areas of approximately 43,050 ha.

a. Subtract Figure 3-20 of the potentiometric surface of the upper bedrock in Appendix IR42-1 by the bedrock top structure, hatch and the confined areas. Note, the confined area will be much larger when the reservoir is under usage.

b. Explain if it is in the confined condition to the East and South-East of the off-stream dam.

c. Simulate the loading effect if it is in the confined condition to the East and South-East of the off-stream dam.

d. Subtract the water level in bedrock under the situation of loading effect by the DEM.

e. Estimate the area of the potential artesian areas.

f. What is the highest water level above DEM in the potential artesian areas?

g. Propose a monitoring plan to monitor the potential loading effect and explain how this plan was created.

h. Design a mitigation plan to reduce or eliminate the potential artesian impact and explain how this plan was created.

Response

This response will be included in a future filing.

Question 50

Supplemental Information Request 1, Question 237, Page 5.36

Alberta Transportation states *The original groundwater LAA did include the area over which potential "loading effects" could occur…*

Alberta Transportation did not complete the potential loading effects analysis. It is only argued that the bedrock is under unconfined or semi-confined conditions in the whole Regional Assessment Area (RAA), so it is impossible to have a loading effects in the RAA. The problem is that potential loading effects to the East and South-East of the off-stream dam may exist when the off-stream reservoir is under usage.

a. **Modify the extent of the LAA to the East and South-East of the off-stream dam to include the area affected by the potential loading effects.**

b. **Analyse the impact of the LAA change to the land purchase and management.**

Response

This response will be included in a future filing.

Question 51

Supplemental Information Request 1, Question 240, Page 5.37 – 5.38

Alberta Transportation states *b-c. There are no differences in the model at local versus regional scales because these two scales are fully accounted for.*

The RAA covers an area approximately 43,050 ha. The regional geological model can not capture the important features which are valuable to the local impact assessment, such as the diversion channel and the off-stream dam seepages' prediction, and the potential loading effects analysis to the East and South-East of the off-stream dam.

a. **Compare the following wells' drilling logs vs the geological units at the same location from the RAA geological model. How big is the difference between:**

    i. **MW16-16-11, MW16-18-10;**

    ii. **MW16-24-30, MW16-23-26, MW16-22-26?**

b. Explain the impact on the diversion channel and the off-stream dam seepages' prediction.

c. Evaluate the impact on the potential loading effects delineation, monitoring and mitigation.

Response

a. The geological model accurately represents the borehole drilling data.

The drilling logs have been interpreted in the context of the local geological/hydrogeological setting to determine the hydrostratigraphic units that govern groundwater flow. The stratigraphic contacts for each borehole log are used to create the geological contact surfaces and generate volumes in the geological model. The geological model uses implicit modelling to accurately represent the drilling logs. The implicit modelling approach uses algorithms to create three-dimensional (3D) surfaces and volumes directly from measured data and user interpretation. The only difference between the borehole logs and modelled geology is a result of the interpolation which is accomplished using radial basis functions (RBF). RBF's are a group of functions used to generate values for the surfaces that define the 3D model. The values generated are a function of the distance to a data point. This interpolation would not change, whether modelling at a local or regional scale.

The export of the model to FEFLOW uses a minimum unit thickness of 0.1 m and a very closely spaced supermesh to represent the PDA so that the detail of the geological model is not lost.

i. Figure 51-1 presents a comparison between the lithology described at MW16-16-11and MW16-18-10 and the geological model. The vertical borehole traced for both records are presented in the figures with the lithological units represented by the colours presented in the legend. The model represents the borehole lithology with the contacts varying slightly due to the interpolation between boreholes described above.

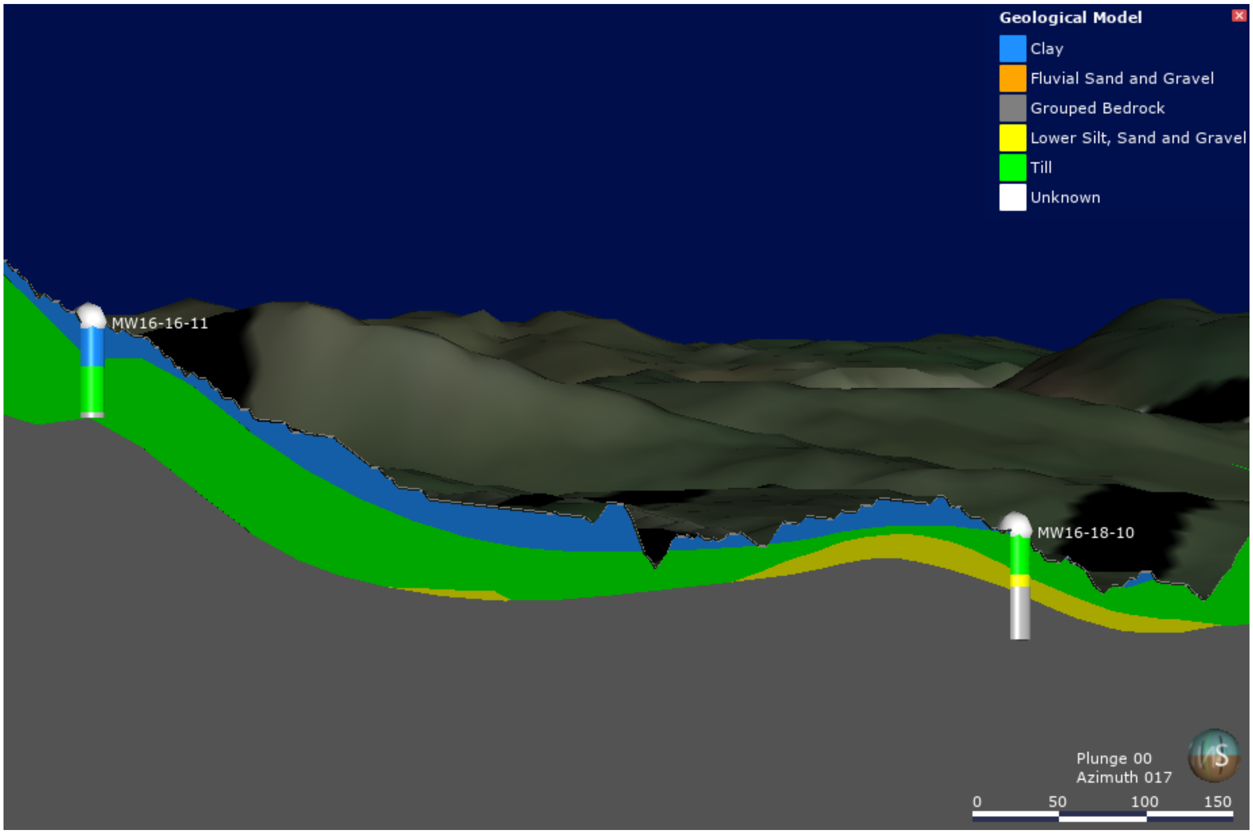


Figure 51-1 Comparison between Borehole Data and Geological Model for MW16-16-11 and MW16-18-10

ii. Figure 51-2 presents a comparison between the lithology described at MW16-24-30, MW16-23-26, MW16-22-26 and the geological model.

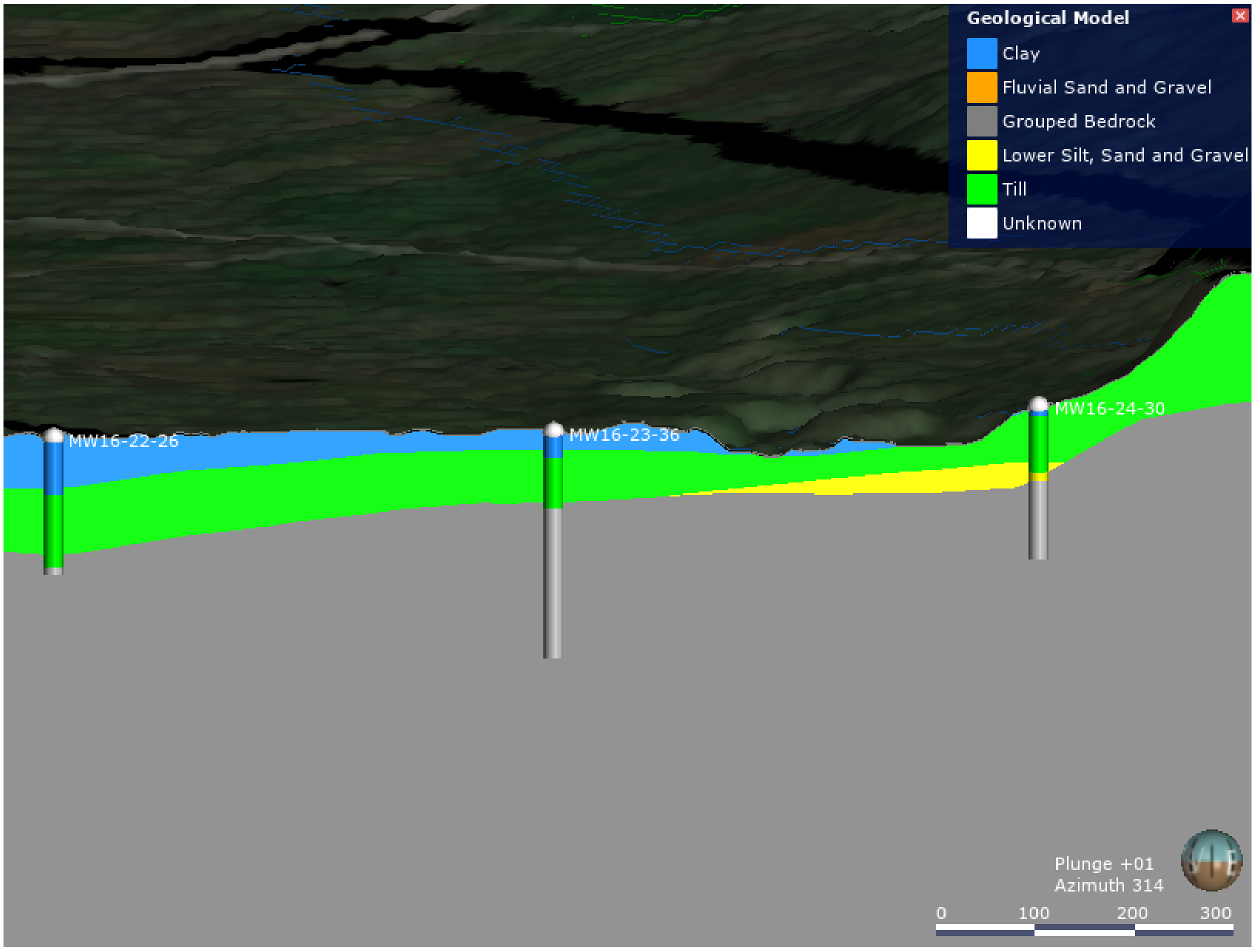


Figure 51-2 Comparison between Borehole Data and Geological Model for MW16-22-26, MW16-23-36, and MW16-24-30

b. Because the geological model accurately represents the borehole drilling data at a local scale there is no impact on the diversion channel and the off-stream dam seepage prediction.

c. Because the geological model accurately represents the borehole drilling data at a local scale there is no impact on the delineation of potential loading effects, or on plans for monitoring and mitigation of potential effects on groundwater. Monitoring and mitigation plans will continue to focus on areas where there are potential risks to groundwater, considering both the locations of potential receptors and areas more susceptible to effects on groundwater (e.g., existing domestic wells near Project infrastructure, existing spring locations or topographically low areas immediately adjacent to Project infrastructure). The monitoring and mitigation plans put into place will allow for ongoing monitoring of groundwater conditions and adaptive management of effects, should they be detected and require implementation of active measures.

Question 52

Supplemental Information Request 1, Question 248, Page 5.48;
Supplemental Information Request 1, Appendix IR42-1, Page 4.8
Supplemental Information Request 1, Appendix IR42-1, Figure 4-10, Figure 4-11, Page 4.12
Supplemental Information Request 1, Appendix IR42-1, Table 3-1, Page 3.33

Alberta Transportation states *Section 4.3.2 of the hydrogeology TDR Update (see the response to IR42, Appendix IR42-1) describes the parameterization of model layers. Hydraulic conductivity values for each of the model layers was parameterized based upon the hydraulic framework developed within the 3D CSM and on results of the steady state calibration runs.*

The undifferentiated bedrock unit was represented in the model with two layers, and the upper layer of the bedrock (Layer 6) was assigned higher hydraulic conductivity values to reflect the potential for this unconformable surface to be fractured and of higher permeability than the underlying bedrock (Layer 7). P.4.8 of Appendix IR42-1.

The assigned conductivities in Layer 6 and Layer 7 are 1.4E-6 m/s and 2.7469E-7 m/s, respectively (Figure 4-10 and Figure 4-11 of Appendix IR42-1). The Paskapoo formation, which is an aquifer in the Province of Alberta, has a magnitude of only one to two smaller than that of the only tested conductivity of 1.5E-5 m/s (MW15-24-30, Table 3-1 of Appendix IR42-1).

a. Explain why the Paskapoo formation, which is an aquifer in the Province of Alberta, is not separated from the rest of the bedrock.

b. Explain what the impact is when a lower conductivity for the model calibration and prediction has been assigned.

Response

a. The Paskapoo Formation can broadly be considered an aquifer in Alberta due to its use for water supply; however, lithologically it is a highly heterogenous formation with several subunits of variable permeability. Although the term Paskapoo Aquifer is often used, as Lyster and Andriashek (2012) state, much of the formation is made up of muddy sedimentary rock that makes up the Lacombe Member that, due to its lower bulk hydraulic conductivity, is considered an aquitard. It is the higher transmissivity sand units within the Paskapoo Formation that can generally be considered aquifers in the Province of Alberta. The Haynes Member of the Paskapoo Formation, also known as the Haynes Aquifer, is the sandstone dominated member (Lyster and Andriashek 2012) and it is not present in the RAA. It is the Lacombe Member of the Paskapoo Formation that subcrops beneath the RAA, and as such, contiguous, regional scale sandstone units are not expected in the RAA.

All bedrock units, including the Brazeau, Wapiabi, Coalspur and Paskapoo Formations in the RAA, were found to have similar lithologies (alternating sandstone, siltstone and claystone), and are inferred to have similar hydraulic properties. This inference is supported by regional mapping by HCL (2002), which indicates that the permeable units of the Brazeau, Coalspur and Paskapoo Formations have a similar range of apparent transmissivity in the RAA. As such, for the purposes of numerical modeling, the Paskapoo Formation has not been subdivided from the rest of the bedrock units.

b. As shown in the subcrop map in response to AEP Question 55 (Figure 55-1), there were 19 Project monitoring wells completed within the subcrop area of the Paskapoo Formation. Seven of the monitoring wells were completed into bedrock of the Paskapoo Formation and hydraulic conductivity testing was completed on three monitoring wells (MW16-6-20, MW16-8-19, and MW16-24-30). In addition, the 37 single-packer permeability tests completed as part of the geotechnical field program were conducted on boreholes completed into the Paskapoo Formation; there is confidence with the conductivity values used for the initial conditions in the numerical model and the calibrated hydraulic conductivity values. There is a range of hydraulic conductivity in the Paskapoo Formation with higher values in the permeable sandstone and lower in the siltstone/claystone; however, given the nature of the channelized, discontinuous sand units within the formation, it is the bulk hydraulic conductivity that governs groundwater flow at the scale of the assessment boundaries.

Model sensitivity analysis was conducted as part of the TDR Update, Appendix E (see Alberta Transportation's response to Round 1 NRCB IR42, Appendix IR42-1) to examine the effect of hypothetically increasing the permeability of both the till and bedrock units within the model well beyond the values that were calibrated for these layers within the RAA. During the sensitivity analysis, the hydraulic conductivity values for these units were increased by a factor of 1,000 (well beyond the respective range of natural variability of these geologic materials). The sensitivity analysis results suggest that the model simulations are most affected by how the hydraulic conductivity values have been assigned. The higher conductivity values (relative to the calibrated values) in the model sensitivity runs lead to further propagation of effects. However, even when increasing the hydraulic conductivity values of the low conductivity units, the modelled effects remain within the LAA and north of Elbow River.

References

HCL (Hydrogeological Consultants Ltd.). 2002. M.D. of Rocky View No. 44 Part of the South Saskatchewan River Basin Tp 021 to 029, R25 to 29, W4M & Tp 023 to 029, R01 to 06, W5M Regional Groundwater Assessment. March 2002.

Lyster, S. and Andriashek, L.D. 2012. Geostatistical rendering of the architecture of hydrostratigraphic units within the Paskapoo Formation, central Alberta; Energy Resources Conservation Board, ERCB/AGS Bulletin 66, 103 p.

Question 53

Supplemental Information Request 1, Question 250, Page 5.49 – 5.50

Alberta Transportation states c. *Two layers were created for the bedrock unit.*

a. What is the thickness assigned to the upper bedrock layer (Layer 6)? Explain.

Response

a. The thickness of the upper bedrock layer (Layer 6) in the updated model presented in the Hydrogeology TDR Update (see Alberta Transportation's response to Round 1 NRCB IR42, Appendix IR42-1) is 8 m. The thickness was used to approximate the highly weathered and fractured upper portion of the bedrock. While the fractured bedrock extends deeper than 8 m, the upper portion is expected to have more connected and open fractures (i.e., not re-mineralized) than the lower bedrock. The borehole log observations and hydraulic conductivity testing results within the upper bedrock indicate that the change is gradational. To address the variability, the thickness of the upper bedrock layer was varied from 5 m to 20 m during model calibration. A layer thickness of 8 m yielded the best calibration results and was carried forward in the subsequent simulations.

Question 54

**Supplemental Information Request 1, Question 251, Page 5.50
Supplemental Information Request 1, Appendix IR42-1, Figure 5-3, Page 5.5**

Alberta Transportation states c. *The time varying boundary conditions were applied to the uppermost layer of the model. This was done to simulate the effect of temporary retaining water on the land surface in the off-stream reservoir.*

The time varying boundary conditions should be match to the reality. If the river cuts to the second or third layers of the model, the river boundary should be applied to all of the second and third layers. Similarly, some areas in the off-stream reservoir have bedrock out-crops, and in this case, the time varying boundary conditions should be applied from the top to the bedrock layers. Otherwise, the model can not mimic real situations.

For potential loading effects simulation to the East and South-East of the off-stream dam, it is the pressure response instead of the water particle movement; to evaluate the potential loading effects from the conservative point of view, the boundary condition in Figure 5-3 (Appendix IR42-1) should be applied in the confined bedrock layer in the area of the off-stream reservoir.

a. Apply the boundary condition in Figure 5-3 (Appendix IR42-1) from the top layer to the bedrock layer in the area of the off-stream reservoir, then simulate the loading effects to the East and South-East of the off-stream dam.

b. Provide a map to show the area of the potential loading effects.

Response

This response will be included in a future filing.

Question 55

Supplemental Information Request 1, Question 255, Page 5.53 – 5.54
Supplemental Information Request 1, Appendix IR42-1, Table 3-1, Page 3.33

Alberta Transportation states *c. However, the behavior of a given water bearing bed within a thick formation like the Paskapoo can vary significantly from the average vertical and horizontal hydraulic conductivity. The low permeability is consistent with available data for the eastern part of the RAA.*

a. The only tested conductivity in the Paskapoo formation can be found in the eastern part of the RAA and has a value of 1.5E-5 m/s (MW16-24-30, Table 3-1 of Appendix IR42-1). Was other tested data available for the Paskapoo formation in the RAA? If so, explain why this data was not included in the RAA and the implications its exclusions may have. If there was no further tested data in the RAA to support the above statement, modify the conductivity for Paskapoo formation to reflect the practical situation in the RAA instead of the summarized conductivity from all the bedrock layers.

b. Re-do the calibration and prediction, including the seepage amount under the off-stream dam. Explain the calibration and prediction methodology used.

c. Analyze and explain the differences of the calibrations and predictions for both the lower and higher conductivities for Paskapoo formation.

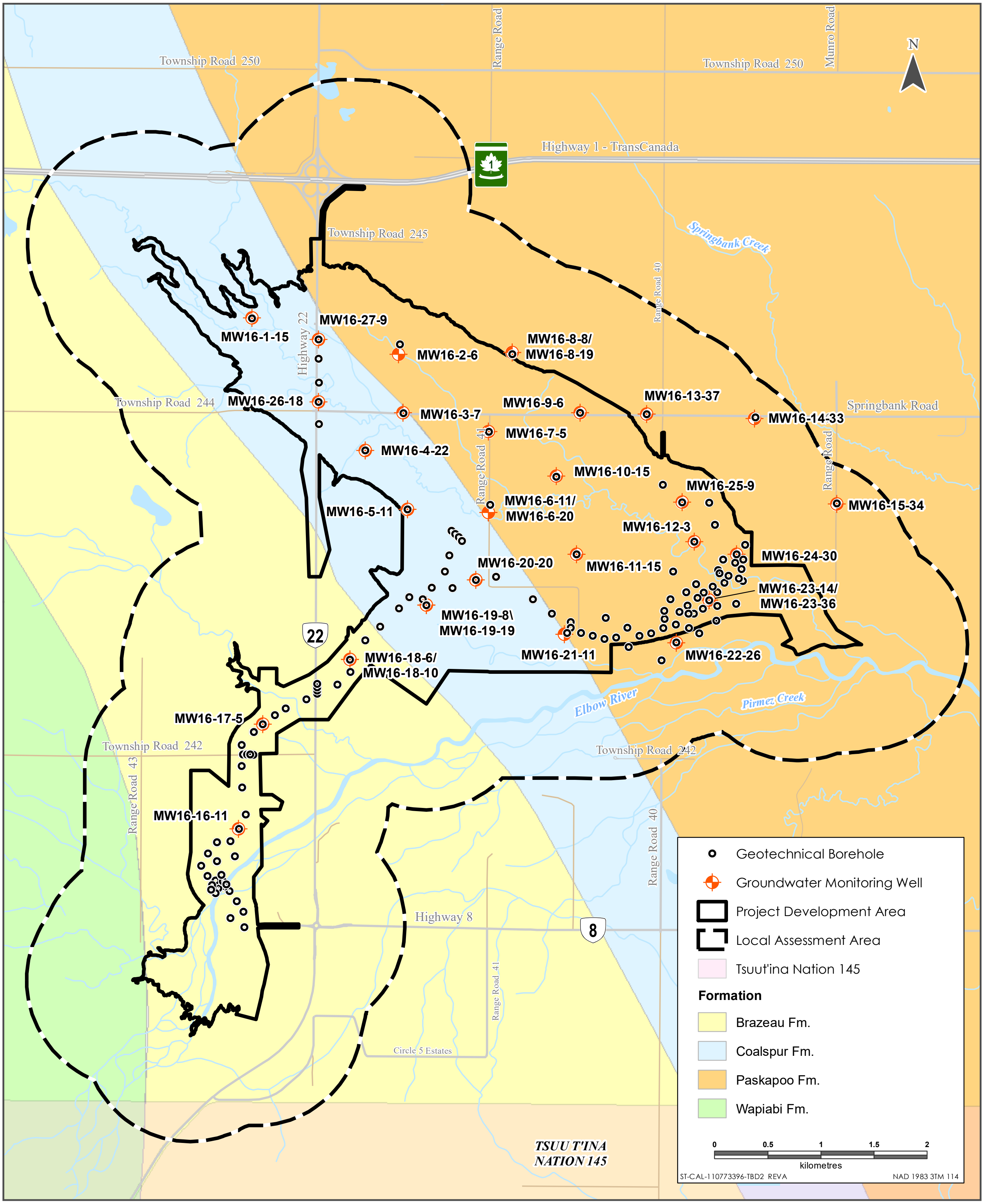
Response

a. As shown in the bedrock subcrop map in Figure 55-1, there were 19 Project monitoring wells completed within the subcrop area of the Paskapoo Formation. Seven of the monitoring wells were completed into bedrock of the Paskapoo Formation and hydraulic conductivity testing was completed on three monitoring wells (MW16-6-20, MW16-8-19, and MW16-24-30). In addition, the 37 single-packer permeability tests completed as part of the geotechnical field program were conducted on boreholes completed into the Paskapoo Formation; there is confidence in the conductivity values used for the initial conditions in the numerical model and the calibrated hydraulic conductivity values.

There is a range of hydraulic conductivity in the Paskapoo Formation with higher values in the permeable sandstone and lower in the siltstone/claystone; however, given the nature of the channelized, discontinuous sand units within the formation, it is the bulk hydraulic conductivity that governs groundwater flow at the scale of the assessment boundaries.

b. Based on the response to a., the model calibration and prediction have not redone because the hydraulic conductivity value applied in the model considered a range of estimates derived from multiple single well tests and isolation packer tests. However, the sensitivity analysis presented in the TDR Update, Attachment E (see Alberta Transportation's response to Round 1 NRCB IR42, Appendix 42-1) examines hypothetical changes to the modelled hydraulic conductivity values, as summarized in the response to c.

c. As stated in the response to a., there is confidence in the conductivity values used for the initial conditions in the numerical model and the calibrated hydraulic conductivity values. However, the model sensitivity analysis presented in the TDR Update, Attachment E does examine the hypothetical effect of increasing the permeability of both the till and bedrock layers within the model. The hydraulic conductivity values for these units were increased by a factor of 1,000 (well beyond the expected range of natural variability of these geologic materials). The sensitivity analysis results suggest that the model simulations are most affected by parameterization of hydraulic conductivity values, and the higher conductivity values lead to further propagation of effects and, in turn, a larger area of effects. However, even when increasing the hydraulic conductivity values of the low conductivity units, the modelled effects remain within the LAA and north of Elbow River.



Sources: Base Data - Government of Alberta, Government of Canada, Thematic Data - Stantec Ltd.

Groundwater Monitoring Well and Geotechnical Borehole Locations Relative to Bedrock Subcrop

Stantec

Figure 55-1

Question 56

Supplemental Information Request 1, Question 257, Page 5.56
Supplemental Information Request 1, Appendix IR42-1, Figure 5-7, Page 5.13
Supplemental Information Request 1, Appendix IR42-1, Figure 5-9, Page 5.16

Alberta Transportation states *a, c. The numerical model was run using unconfined conditions given the limited lateral extent of confining layers*

The regional model has an area of approximately 43,050 ha. The RAA has the limitation that it is unable to solve the problems for Diversion Channel seepage and the potential loading effects to the East and South-East of the off-stream dam. Not only is it not efficient, but the site specific problems are overlooked. The drawdown and groundwater level anomaly along the diversion channel (Figure 5-7, and Figure 5-9 of the Appendix IR42-1) may also belong to the regional model limitation as well.

As per the September 6, 2018 meeting between Alberta Environment and Parks, Alberta Transportation and Stantec two local models were recommended and are required to understand and solve the diversion channel seepage and the potential loading effects. Provide:

a. A local model for diversion channel seepage prediction.

b. A local model around the off-stream dam for loading effects analysis and prediction.

Response

This response will be included in a future filing.

4.2 HYDROLOGY

Question 57

Supplemental Information Request 1, Question 261, Page 5.68

Alberta Transportation states *The runoff volume related to the 2013 flood was calculated based on the hydrograph at Glenmore Reservoir, and the off-stream reservoir is designed to accommodate such a flood.*

a. Provide the data source of the hydrograph at the Glenmore Reservoir.

Response

a. The initial inflow hydrograph for the 2013 flood into the Glenmore Reservoir was an estimate provided by the City of Calgary. The hydrograph was based on calculations using Glenmore Reservoir level (change in retained volume) and outflow.

   The Water Survey of Canada released hydrograph data in January 2017 for the two upstream hydrometric stations at Bragg Creek and Sarcee Bridge. A comparison of this updated data to the initial estimates confirmed no changes to the Project design or hydrology assessment are required.

   See Alberta Transportation's response to Round 1 AEP IR260 for additional detail on the hydrograph comparison.

Question 58

**Supplemental Information Request 1, Question 269, Page 5.83
Supplemental Information Request 1, Appendix IR302-1, Page 4.3
Supplemental Information Request 1, Question 276, Page 5.94**

Alberta Transportation has referred to Appendix IR302-1 in SIR1 question 269 response. Alberta Transportation states in the Surface Water Monitoring Plan (Appendix IR302-1, page 4.3) *maintenance activities in the PDA to prepare the infrastructure for the next flood that would have a portion of its waters directed into the off-stream reservoir (from a decade to decades in the future).*

Alberta Transportation also states *The operation of the reservoir will occur infrequently (once every ten years), so the nature of the change is not anticipated to change the water quality of Elbow River or Glenmore Reservoir.*

a. **Explain what is meant by the next diversion will occur *from a decade to decades in the future*?**

b. **Explain what is meant by the operation of the reservoir will occur *once every ten years*?**

c. **In both of these cases, are the terms *decade* and *once every ten years* referring to 1:10 year flood events when the flow will exceed 160 m^3/s which is close to the 1:10 year flood event? If so, then this is an incorrect interpretation of the definition of a 1:10 year flood event, to address frequency of maintenance activities and risk associated with water quality. The term 1:10 year flood indicates the probability of occurrence of that flood in a given year.**

d. **Provide the timeline by which the maintenance activities will be completed after a flood, so that the infrastructure is prepared for the next 1:10 year or bigger flood events that may occur the following year.**

e. **Explain what types of impacts the project may have on downstream licence withdrawals in the event the project is in operation more frequently (for example, with less than ten years gap in-between operations).**

Response

a. The reference to "decade to decades" is a qualitative description of the frequency of operation of the Project, based on the current understanding of flood frequency. The flow threshold for activation of the Project is 160 m^3/s, which has an annual exceedance probability of 1:7 or 14%.

b. Over the available period of records of the last 105 years, Elbow River flows exceeded 160 m^3/s approximately 10 times, which averages to once every 10 years. This is an approximation because, as can be seen in Figure 58-1, there have been spans of 30 or more years which did not have flooding large enough that would have triggered Project flood operations. Conversely there was a period between 2005 and 2011 where the Project would have operated three times.

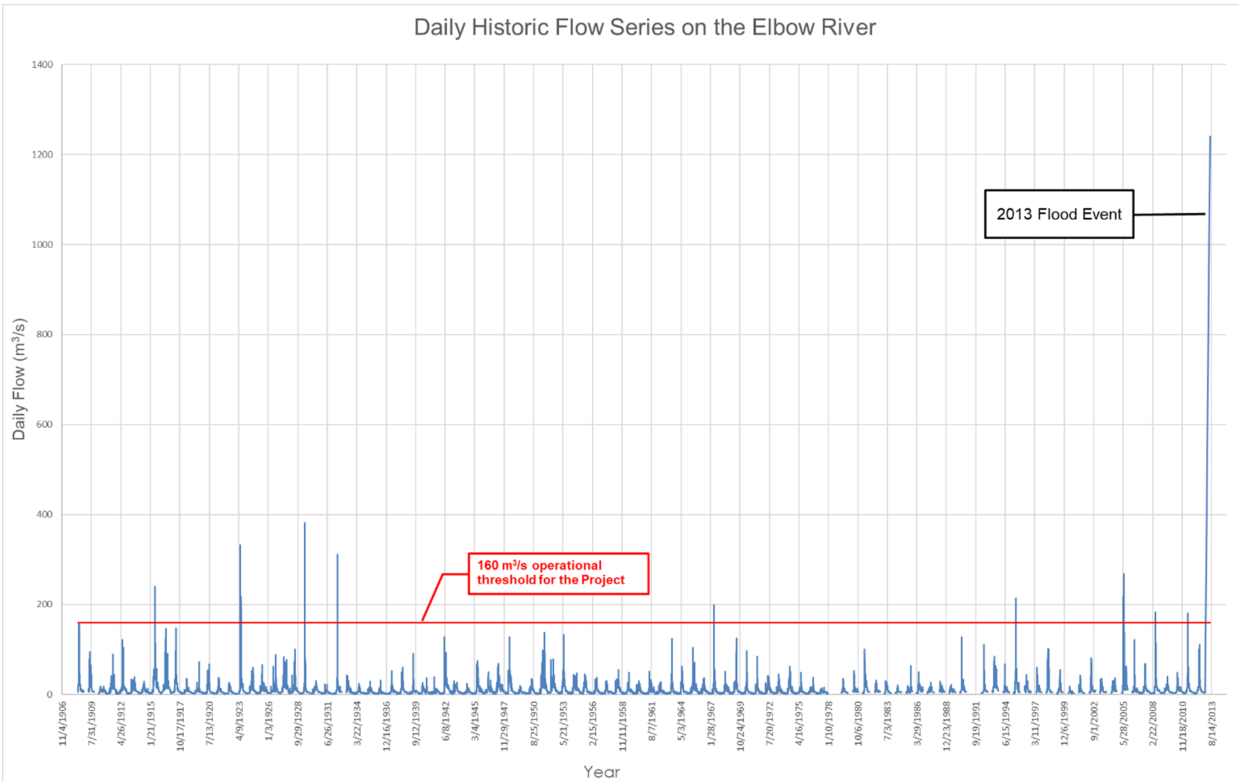


Figure 58-1 Historic Flows in Elbow River

c. As described in the responses to a. and b., the flood scenarios are used to qualitatively describe the Project's expected frequency of operation. As stated in the response to a., the operational threshold of 160 m^3/s is equivalent to a 1:7 year flood flow and has an approximately 14% chance of occurring in any given year.

d. Post-flood maintenance activities would be completed in the same year as a flood event, following full drawdown of the reservoir and once the risk of additional floods have passed. Depending on the magnitude of the flood and its impacts, maintenance activities could range from days to months.

Annual inspections will be carried out in advance of each flood season, so the Project is prepared for operation. Any maintenance activities identified by the inspections will be completed prior to the onset of the flood season.

e. Flood operations of the Project will only occur when river flows are greater than 160 m^3/s so that flood flows in the river remain at 160 m^3/s, leaving ample surface water available for downstream users. Available withdrawal rates for licences downstream of the Project total a maximum of 13.35 m^3/s. This equates to roughly 8.3% of the available 160 m^3/s total river flow while the project is diverting. The largest licence on Elbow River is the City of Calgary, which can divert up to 12.74 m^3/s.

Regardless of the Project's frequency of operation, downstream withdrawal licences will not be curtailed or affected since diversion during Project operation does not occur until flows on the river exceed 160 m^3/s and that flow will be maintained, even with diversion.

In addition, the holder of the largest of the downstream water licence receives a direct benefit in water security from the project as they will no longer need to allocate as much active storage in Glenmore Reservoir to flood control. Other downstream water licence holders with infrastructure on the Elbow River will receive a direct benefit from the Project by its reduction in flood risk to their infrastructure.

Question 59

Supplemental Information Request 1, Question 272, Page 5.86

a. **The response to SIR1 question 272 is not relevant to the question asked. Provide the correct response.**

Response

a. the Hydrogeology TDR Update (see Alberta Transportation's response to Round 1 NRCB IR42, Appendix 42-1) provides additional baseline and modelling results, that replaces the Hydrogeology TDRs provided in the EIA, Volume 4, Appendix I.

The Project has the potential to change groundwater quantity through groundwater seepage into the diversion channel when dry (i.e., when the Project is not in operation). Groundwater seepage into the dry diversion channel would occur only in areas where the diversion channel is excavated to an elevation below the water table. Groundwater that seeps into the diversion channel (when dry) would infiltrate back into the groundwater system at a downstream location that is not saturated or continue to flow by gravity down the diversion channel and into the off-stream reservoir. Once there, groundwater seepage collected in the off-stream reservoir may infiltrate back into the ground (returning to the groundwater system) or, where the local infiltration capacity is exceeded, continue to flow overland into existing surface water drainage courses. There, groundwater seepage would become part of the surface water system, eventually draining through the outlet structure. The rate of groundwater seepage has been estimated to be small (approximately 0.013 m^3/s) relative to the baseline surface water flows (approximately 4 m^3/s during low flow winter months) in the local area, as is presented in the Hydrogeology TDR Update, Section 5.5.1.

To better understand how groundwater might react due to the Project during dry operations, a finite element subsurface flow and transport system (FEFLOW) groundwater model was developed to simulate current conditions and Project conditions. The modelling found that the net change in hydraulic head attributable to the Project during dry operations are limited to areas within and adjacent to the diversion channel (Figure 59-1).

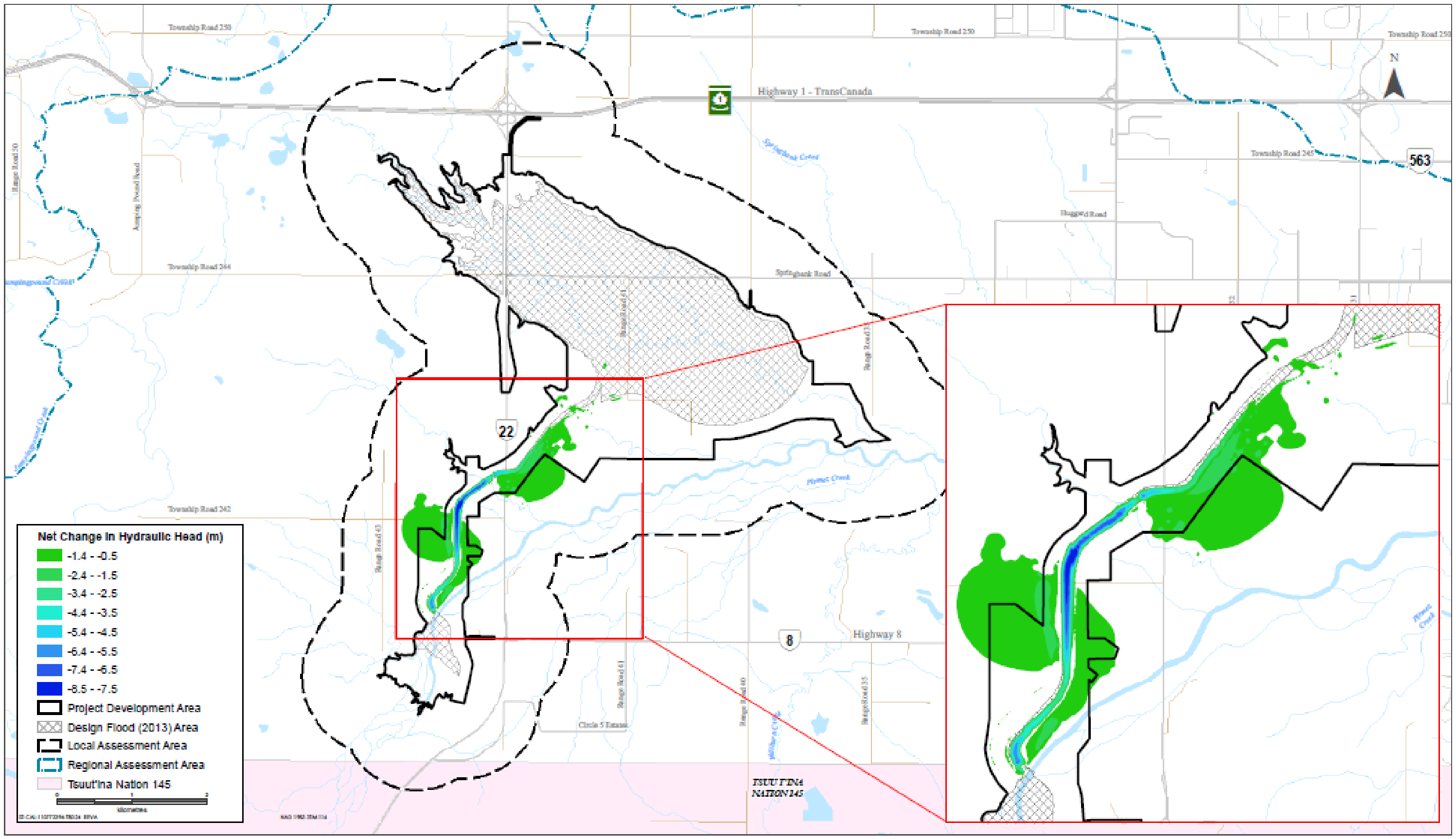


Figure 59-1 **Simulated Net Change in Hydraulic Head**

In southwestern areas of the diversion channel (near the inlet structure), net negative changes in groundwater levels of up to 7.5 m are predicted due to the incision of the diversion channel into the ground surface below the groundwater table level. Excavation of the diversion channel results in seepage at the face, causing localized lowering of the groundwater table as groundwater discharges into the dry channel. The extent of the changes in potentiometric head (i.e., the elevation of the water table) are limited to near the diversion channel and well within the LAA.

Question 60

Supplemental Information Request 1, Question 274, Page 5.88
Supplemental Information Request 1, Appendix IR274-1, Table IR274-1, Page 274-1.1
Supplemental Information Request 1, Appendix IR274-1, Table IR274-2, Page 274-1.15

a. Identify the ten groundwater and six surface water licences located within the PDA that will be affected, in Table IR274-1 and Table IR274-2 of Appendix IR274-1.

Response

a. The six affected surface water withdrawal licenses referenced in Alberta Transportation's response to Round 1 AEP IR274c are provided in Table 60-1, which also includes one additional surface water license not originally referenced in IR274c, Appendix IR274-1, Table IR274-2; this is highlighted in **red**.

The ten affected groundwater license holders within the PDA referenced in IR274c are provided in Table 60-2.

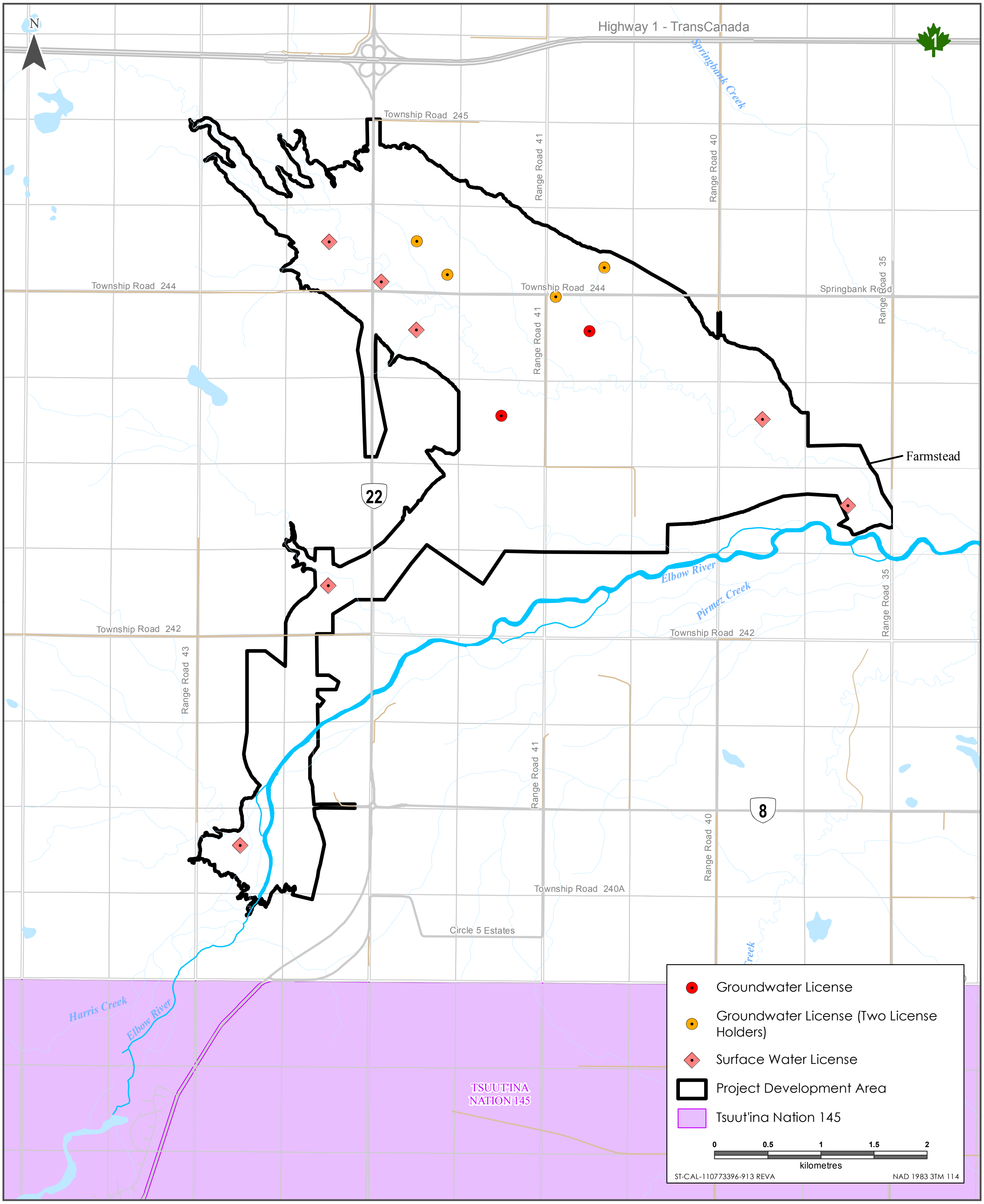
Figure 60-1 provides the location of the groundwater and surface water licenses within the PDA. The ten groundwater license holders share six groundwater licenses, which are shown on Figure 60-1. Refer to Table 60-2 for groundwater license details.

Table 60-1 Surface Water Licences and Allocations in the PDA

Priority	Applicant	Project	Interim_licence_number	Approval ID	Latitude	Longitude
19880318005	ALBERTA TRANSPORTATION	ALTA TRANSPORTATION, WR, 41777	14359	23525	51.0679	-114.4657
19641231087	COPITHORNE, ROBERT	COCHRANE/FARM UNIT/COPITHORNE ROBERT - F00163401	00163401 00 00	163401	51.071202	-114.460933
19631231195	MARSHA WAGNER	CALGARY/FARM UNIT/WAGNER MARSHA-F00183452	00183452 00 00	183452	51.071262	-114.472721
18940701056	GARDNER CATTLE COMPANY LTD	CALGARY/FARM UNIT/GARDNER CATTLE CO - F00160591	00160591 00 00	160591	51.04919	-114.402784
19981229540	**COPITHORNE, BRIAN**	**COCHRANE/FARM UNIT/COPITHORNE BRIAN - F00163271**	**00163271 00 00**	**163271**	**51.0201**	**-114.484139**
19821231076	COPITHORNE, SAM	COCHRANE/FARM UNIT/COPITHORNE SAM - F00161652	00161652 00 00	161652	51.05644	-114.41432
19661231058	COPITHORNE, ROBERT	COCHRANE/FARM UNIT/COPITHORNE ROBERT - F00163401	00163401 00 00	163401	51.04215	-114.472543

Table 60-2 Groundwater Licences and Allocations in the PDA

Priority	Applicant	Project	Interim_licence_number	Approval ID	Latitude	Longitude
19890417014	COPITHORNE, ROBERT	COPITHORNE, WR, 23670	16787	27702	51.0684	-114.4568
19890417014	COPITHORNE, BRIAN	COPITHORNE, WR, 23670	16787	27702	51.0684	-114.4568
19890417013	COPITHORNE, ROBERT	COPITHORNE, WR, 23670	16786	27703	51.0666	-114.4422
19890417013	COPITHORNE, BRIAN	COPITHORNE, WR, 23670	16786	27703	51.0666	-114.4422
19611231213	COPITHORNE, ROBERT	COCHRANE/FARM UNIT/COPITHORNE BRIAN - F00163271	00163271 00 00	163271	51.071202	-114.460943
19611231214	COPITHORNE, BRIAN	COCHRANE/FARM UNIT/COPITHORNE BRIAN - F00163271	00163271 00 00	163271	51.071202	-114.460943
19890417010	COPITHORNE, ROBERT	COPITHORNE, WR, 23670	16784	27705	51.0691	-114.4357
19890417010	COPITHORNE, BRIAN	COPITHORNE, WR, 23670	16784	27705	51.0691	-114.4357
19821231072	COPITHORNE, ALAN	COCHRANE/FARM UNIT/COPITHORNE ALAN - F00161619	00161619 00 00	161619	51.05649	-114.449413
19601231161	COPITHORNE, KATHLEEN	BRAGG CREEK/FARM UNIT/COPITHORNE KATHLEEN - F00163116	00163116 00 00	163116	51.063666	-114.437635



Sources: Base Data - Government of Canada. Thematic Data - Government of Alberta

Groundwater and Surface Water Licenses within the PDA

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ALBERTA TRANSPORTATION SPRINGBANK OFF-STREAM RESERVOIR PROJECT ENVIRONMENTAL IMPACT ASSESSMENT

Figure 60-1

Question 61

Supplemental Information Request 1, Question 289, Page 5.114

Alberta Transportation states *The influence of all aspects of water operations on hydrology, due to the combined operations of the Project and the Glenmore Reservoir*.

a. **This sentence is not complete. Provide the complete sentence and fully address the questions asked in 289(a).**

Response

This response will be included in a future filing.

4.3 SURFACE WATER QUALITY

Question 62

Supplemental Information Request 1, Question 293, Page 5.124—5.130
Volume 3A, Section 6, Figure 6-12, Page 6.31
Volume 4, Appendix J, Section 2.4.2, Page 2.32

Alberta Transportation identified the boundary condition of the three modelling domains. No tributaries were identified. For example, for Model Domain (I) there were no tributaries identified to supplement the flow and suspended sediment loading coming from the upstream boundary condition at Bragg Creek. However, Figure 6-12, V. 3A, S06 includes five tributaries in the local assessment area. Furthermore, Vol 4-J page 2.32 indicates that the flow of tributaries between Bragg Creek and Sarcee Bridge was estimated.

a. Indicate how the flow and sediment from tributaries were considered in the model input.

b. If no tributaries were considered, explain why not and include the implications for sediment transport and water quality.

c. How would this affect the uncertainty of the modelling results?

Response

a. Hydrologic modelling was undertaken to understand the flow contributions from the tributaries to the Elbow River mainstem. Flow and sediment from tributaries were not considered in the Mike21 MT model.

b. The contribution of flow and sediment from the tributaries entering Elbow River downstream of the Project are not changed by the Project and, therefore, would not be relevant for the assessment. The relative contribution of flow from tributaries downstream of the Project is approximately 10% of the total flow in the mainstem for the three hydrographs assessed.

   The timing of the peak flows from the tributaries would likely occur prior to the Elbow River peak flow; thus, their contributions to sediment transport and water quality would likely occur prior to Project operation. The contribution of flow and sediment from tributaries upstream of the Project are accounted for in the model input as the information used is representative of all upstream contributions.

c. One of the objectives of the Mike21 MT model is to model effects of the Project on flow and sediment transport in Elbow River relative to baseline conditions. Contributions of flow and suspended sediment from the tributaries to Elbow River are not changed by the Project. These contributions potentially have different timing (peak prior to the Elbow River peaks) and are minor contributors to sediment transport and water quality (i.e., TSS) relative to what would be in the Elbow River mainstem. Therefore, not including the tributaries in the Mike21 MT model does not add to the model uncertainty related to predictions.

Question 63

Supplemental Information Request 1, Question 295, Page 5.131—5.134

Alberta Transportation discussed the implications of using different lengths of time to drain the reservoir (SIR1 295 [a]). However, the different scenarios presented with variations of gate openings do not provide the estimation of the TSS concentrations expected.

a. For the three scenarios (release gate at 75%, 50%, and 25% open), indicate the predicted average and maximum TSS concentrations:

   i. leaving the reservoir; and

   ii. in the Elbow River 1 km below the confluence with the unnamed Creek

b. Compare and discuss these results with the previously provided results when the gate is 100% open.

Response

This response will be included in a future filing.

Question 64

Supplemental Information Request 1, Question 296, Page 5.138

Alberta Transportation states *In this study, the dry, flood and wet depths were set to 0.01, 0.05 and 0.1 m, respectively*.

a. Confirm that the depth of 0.05 m represents flood and 0.1 m wet conditions.

Response

a. The default value for flooding depth (h_{flood}) is 0.05 m and for wetting depth (h_{wet}) is 0.1 m. These values are the recommended values in the Mike 21 Flow Model FM user guide (DHI 2017). The "dry, flood and wet depth" terms represent technical terms specific to the DHI modelling software and are used for computational purposes when a cell in the model is either "dry, flood or wet". These terms do not represent water depths specific to the Project during dry, flood or wet conditions.

REFERENCES

DHI. 2017. MIKE 21 Flow Model FM, Hydrodynamic Module, User Guide. Available at: https://manuals.mikepoweredbydhi.help/2017/Coast_and_Sea/MIKE_FM_HD_2D.pdf.

Question 65

Supplemental Information Request 1, Question 297, Page 5.140—5.142
Supplemental Information Request 1, Question 293, Page 5.124
Supplemental Information Request 1, Appendix IR302-1, Table 9-1, Page 9.4.
Volume 3B, Section 6.4.3.2, Figure 6-15, Page 6.36.

Alberta Transportation indicates through their responses variations of this statement: *Potential changes in water quality (i.e. concentrations and loads) associated with increases in TSS at the end of the period of water release from the reservoir are expected to be small compared to what could be expected during a flood in the absence of the project*. Alberta Transportation explains the effect of the project by having a net reduction of the annual TSS. However, this reduced load is moved from a short high-flow period to a longer clear flow period, and at a more sensitive time of the year for nutrient uptake. The guideline exceedances during the time of release still need to be well characterized for evaluation of the project. As per Table 9-1 in Appendix IR302-1 different exceedance levels are appropriate depending on the background TSS conditions. Without the project, the background concentration is high. However, the post-flood operations will release peak TSS concentrations under a clear period and for over 24 hours.

The report shows results up to 1 km downstream from the release stating this is *i.e. the farthest point in Elbow River downstream where suspended sediment was modelled*. However, the model domain (SIR1 293) is up to the Glenmore Reservoir. The modelling results showed that for the last days of release the sediment concentration would be significantly higher than the background concentration producing guideline exceedance at 1 km below the release (e.g. Figure 6-15, Vol 3B).

a. **What is the spatial extent for potential adverse effects of sediment released from the off-stream reservoir for each flood scenario (i.e. what is the most downstream location where guidelines are exceeded)?**

b. For how many days does the model predict exceedances of instream guidelines for each flood scenario? Identify the change in exposure time for the project (post-flood operations) and current conditions (flood without the off-stream reservoir).

c. Provide graphs and maps to understand the extent of the guideline exceedances.

Response

This response will be included in a future filing.

Question 66

Supplemental Information Request 1, Question 298, Page 5.142—5.143

Alberta Transportation described the potential effects of dissolved oxygen (DO) and temperature in the Elbow River. However, the explanation regarding the DO and temperature in the reservoir indicates that *changes in dissolved oxygen are expected to be smaller than currently observed in Glenmore Reservoir*.

a. Clarify the method used to determine that changes in DO are expected to be smaller than currently observed in the Glenmore reservoir. Explain all uncertainty around this estimation.

b. Indicate the average BOD, and the minimum DO concentration expected in the off-stream reservoir. How can these values affect the assessment of the Project environmental effects on water quality? What measures would be considered to mitigate effects if they are observed?

Response

This response will be included in a future filing.

Question 67

Supplemental Information Request 1, Question 309, Page 5.185-5.186
Supplemental Information Request 1, Question 325, Page 5.202-5.203
Supplemental Information Request 1, Question 309, Table IR309-1, Page 5.186
Volume 3A, Section 7.1.7, Page 7.9

Alberta Transportation indicates that upon release of retained water from the off-stream reservoir predicted total suspended sediment (TSS) concentrations would be well below the predicted peaks for floods that would occur without the project in place. A similar statement is made in SIR1 325 and elsewhere.

In Table IR309-1 Alberta Transportation identifies TSS concentrations in at the end of the release period from the Off-Stream Reservoir at two locations, one at the release site and one at 1 km further downstream.

Alberta Transportation states *The assessment concluded that effects from the predicted sediment concentrations are not significant.* However, the assessment concluded that *"resulting increase in the Elbow River of suspended sediment concentrations is likely to exceed the Canadian Water Quality Guidelines.*

In spite of this, in Volume 3A of the EIA Alberta Transportation provides a significance definition as *a significant adverse residual effect on water quality is defined as a measurable change in water quality that:*

- ***exceeds an implemented water quality objective or site-specific water quality guideline for the protection of aquatic life or***
- ***contravenes a watershed management target or***
- ***causes acute or chronic toxicity to aquatic life or***
- ***changes the trophic status of a lake or stream.***

a. Total net load would be less during the flood year when the off-stream reservoir is in operation as indicated above. Justify and explain why there is no assessment of concentrations of TSS over time (monthly) in August and September at locations downstream of the reservoir from point of release to sites within 1 km of the Glenmore Reservoir.

b. Justify and explain why there was no peak and average values further downstream in the Elbow River, considering this section is approximately 11 km long.

c. Considering the definition of significance, clarify and explain how the TSS guidelines will be exceeded and yet the effects are not significant.

Response

This response will be included in a future filing.

4.4 AQUATICS

Question 68

Supplemental Information Request 1, Question 342, Pages 5.225-5.228

Alberta Transportation states that no quantitative estimates of fish populations (i.e. mark recapture population estimates) were available, and instead used relative abundance. Relative abundance is not effective in detecting changes to fish populations in the absence of baseline data. Population estimates are therefore more appropriate in assessing impacts (changes) to fish populations pre and post dam construction and operation.

Alberta Transportation must undertake population estimates of fish populations both prior and following dam construction and operation. This approach will allow for the detection of differences in fish populations pre and post dam construction/operation to assess whether impacts to fish are as predicted.

a. Provide quantitative population estimates for the fish species found in the Elbow River.

Response

This response will be included in a future filing.

Question 69

Supplemental Information Request 1, Question 343, Pages 5.228-5.229

Alberta Transportation states that fish movement was determined from studies conducted by the Alberta Conservation Association on tributaries of the Elbow River upstream of the diversion structure (Fitzsimmons, 2008). This response does not include findings from Popowich and Paul 2006 reflecting bull trout utilization of the area below the proposed dam site. The time period when the dam would be in use (April-July) would encompass the migratory window for rainbow trout, cutthroat trout/cutthroat hybrids, and bull trout.

a. How were migration patterns of fish species in the Elbow River determined apart from general life history patterns?

b. Re-evaluate fish presence, habitat utilization, and movement in the Elbow River including the work by Popowich and Paul (2006) *Seasonal movement patterns and habitat selection of Bull Trout (Salvelinus confluentus) in fluvial environments* attached. Use this new information as part of the environmental assessment (prediction of impacts) of this project.

Response

This response will be included in a future filing.

Question 70

Supplemental Information Request 1, Question 344, Page 5.230
Supplemental Information Request 1, Question 343, Table IR343-1, Page 5.229
Volume 3A, Section 8.4.2.1, Page 8.49
Volume 3A, Section 8.4.3.8, Page 8.55

Alberta Transportation states that flow would be manipulated (by raising the right gate of the dam) to maintain 20 cm of flow through the fish passage.

Based on this response, fisheries understands that fish passage design will only allow passage of fish in certain size ranges. This creates potential barriers to fish passage which would subsequently impact fish populations (sport and non-sport fish).

a. If non-sportfish are unable to pass, what are the impacts to populations both up and downstream of the diversion structure?

b. Describe mitigation measures to address low water depth which would be a passage restriction to large fish (such as bull trout) during low flow.

c. Describe which of these species moves through the area of the diversion structure where migration may be affected during the times described in the table.

d. Specify the degree to which fish passage will be provided under various flow conditions (species and size ranges for sport and non-sport fish) and develop a monitoring plan to determine effectiveness of fish passage to assess the extent to which the dam is a barrier to fish passage. Include frequency, time of year, and techniques used to monitor.

Response

This response will be included in a future filing.

Question 71

Supplemental Information Request 1, Question 347a, Page 5.234
Volume 3A, Section 8.4.4.2, Page 8.58

Alberta Transportation provided a brief quantification of fish habitat primarily based on a brief survey and a desktop exercise. This question has not been answered sufficiently. Alberta Transportation needs to conduct habitat assessment and mapping to determine baseline habitat downstream of the dam site. Changes may be modelled and offsetting needs to be determined.

a. Identify plans to offset losses in the productivity of the fish habitat identified.

Response

a. Alberta Transportation has engaged Fisheries and Oceans Canada (DFO) to discuss the criteria to offset fisheries-related effects. AEP will be engaged to discuss how these measures may complement local fisheries objectives. These offsetting options will be presented to Indigenous groups for input and feedback regarding how to best support fisheries important to their cultural needs.

A preliminary list of fish habitat offsetting options is provided below. This list may change through consultation with regulators and Indigenous groups; as suitable offsets for the Project are defined, some of these options will be eliminated.

In-Kind Habitat Offsets

Constructed Fish Habitat (Side Channel and Constructed Stream Channel Habitat)

- Constructed side channel habitat and artificial stream channels are effective ways to create habitat that will benefit select life stages (e.g., rearing and feeding habitat, cool water refuge, overwintering habitat) of certain species within the Elbow River valley.
- Constructed side channel habitat has been successfully employed in southern Alberta (e.g., Quarry Park Offset on Bow River); construction techniques for in-kind equivalent habitat are well known (i.e., replacing lost metres of habitat area with constructed metres of habitat).

Constructed habitat may benefit certain species (e.g., brook trout, rainbow trout) more than native bull trout or whitefish; important limiting habitat features (e.g., spawning habitat for fish) may be difficult to recreate in off-stream or constructed side channels without careful environmental considerations (e.g., groundwater flows, gravel source, annual stream flow regime).

Habitat Improvement Offsets

Elbow Lake – Bragg Creek Trail

- Upgrades to the hiking/ATV trail between Elbow Lake and Bragg Creek could be implemented, including tributary crossings, runoff and erosion areas. These upgrades will help reduce sediment yield into the upper reaches of Elbow River and its more sensitive fish habitats.

McLean Creek Erosion and Sediment Control Mitigations (Bridges and Approaches)

- McLean Creek watershed is a local favorite off-road use area; the trails experience heavy use including fording many creeks, draws, and runoff areas. Consequently, these areas generate heavy sediment loads for McLean Creek and Elbow River.
- There is an opportunity to develop permanent trail crossings (bridges and fords) and repair washouts and vulnerable areas. This would reduce the sediment load and associated impacts to resident fish in Elbow River.

Stream Connectivity Repairs

- Damage to culverts and stream crossings during the 2013 flood resulted in smaller creeks and tributaries in the upper foothill watersheds becoming isolated and causing fish migration issues (e.g., tributaries to the Sheep and Highwood rivers, upper Willow Creek near Indian Graves and Trout Creek, among other areas).
- Fixing un-owned stream crossings will restore fish passage to headwater habitats.

Repair Fords in Area Watersheds to Reduce Sediment Yields into Fish Habitats

- Upper Elbow River watershed will need some repairs due to forest management and oil and gas activity.
- The road along the Ghost River upstream of Waiparous into Ghost Wilderness Area (at least three crossings) could be repaired.
- Three Point Creek and Sheep River watershed need repairs due to various agricultural activities.

Fish Passage between Upper and Lower Kananaskis Lakes

- There could be an investigation into fish passage issues between upper and lower Kananaskis Lakes where fish may occasionally become isolated. Corrective measures could be provided to improve passage to protect fish.
- This option might not be feasible under the *Fisheries Act*, which does not allow proponents to receive offsetting credit for restoring habitat belonging to another entity.

Complementary Offset Measures

Forest Hydrology and Water Quality Study of the Upper Elbow River Watershed

- This study would help to better understand the City of Calgary's source water protection needs in the Elbow River watershed and facilitate future planning needs that may have cumulative effects with the off-stream reservoir operations.
- Information to manage and protect Elbow River watershed hydrology and water quality will benefit resident fish populations as well as the City of Calgary's drinking water.

Conclusion

As noted above, this list may change through consultation with regulators and Indigenous groups; as suitable offsets for the Project are defined, some of these options will be eliminated. Details for each relevant offsetting option, including a full offsetting plan, will be developed and submitted with the application for authorization under the *Fisheries Act*. The offsetting plan will be developed with AEP to make sure the plan meets their fish management objectives and will be made available once complete.

Question 72

Supplemental Information Request 1, Question 348a, Pages 5.235-5.236
Volume 3B, Section 8.2.2, Page 8.6
Volume 3B, Section 8.2.2.3, Page 8.10
Volume 3B, Section 6.4.4.1, Table 6-10, Page 6.54
Volume 3B, Section 6.4.4.3, Figures 6.29-6.31, Pages 6.63-6.65

Alberta Transportation states that the impact to fish from the slow release of sediment-laden (potentially high temperature and poor quality water) water from the dam into the side channel and the Elbow River would not be anticipated to result in residual effects on aquatic ecology.

This question has not been answered sufficiently. There appears to be a determination that the release of water from the reservoir that is potentially of poor quality and higher temperatures will not be harmful to fish. This is likely incorrect.

a. Provide a follow-up monitoring plan to identify potential impacts to fish. Describe the surveys/reports that are to be used.

b. Assess water quality conditions that could occur in the dam when in use. Reference those water quality conditions to the potential impacts to fish:

i. in the dam reservoir area; and

ii. potential change in water quality in the Elbow River due to dam water releases.

c. Discuss the impacts to fish resulting from the slow rate of release of turbid water over an extended period of time. Consider the severity of ill effects (SEV) dose-response curve which indicates elevated negative impacts to fish with increasing duration of high sediment events.

d. What are the impacts to fish due to the operation of the auxiliary spillway?

Response

This response will be included in a future filing.

Question 73

Supplemental Information Request 1, Question 349, Page 5.241-5.242

Alberta Transportation states that flows over 160 m^3/s are considered channel forming.

Since the Elbow River routinely experiences flows >160m^3/s altering and/or suppressing the flow regime would affect the quality and quantity of fish habitat downstream in the long term. Prevention of bedload movement would result in the permanent loss and alteration of fish habitat. The alterations that occur include the increasing embeddedness of bed material and increased siltation. This change in substrate would reduce the availability of fish habitat, spawning habitat, and reduce the productivity of the river (i.e. invertebrate communities) which would subsequently impact fish populations.

Operation of the dam will alter channel forming flows downstream of the project site. This includes changes to (reduction) the movement of bed materials and outright loss of woody debris.

a. Map fish habitat downstream of the diversion structure. In addition, conduct an assessment of how habitat would decline over time.

b. What evidence is being cited to conclude that flows over 160 m^3/s are considered channel forming and would shift bed materials to maintain habitat?

c. Is the proposed flow level adequate to maintain riverine processes?

d. Assess the changes to the reduction of movement of bed materials and loss of woody debris. In addition, assess the subsequent impacts to fish habitat over time resulting from dam operation.

e. Map fish habitat upstream and downstream of the diversion structure to provide baseline information for comparison when assessing post dam operations.

Response

This response will be included in a future filing.

Question 74

Supplemental Information Request 1, Question 350, Pages 5.245-5.248

Alberta Transportation states that fish entrainment could be up to 80%, but would likely be lower.

This question has not been answered sufficiently. Fish could be entrained at a higher rate than discussed, and the entrainment rate is not necessarily linear. Alternative rates of entrainment should be considered in regard to potential population level effects due to potential losses resulting from mortality, and also from physical impacts to fish when diverted (i.e. injury, diminished reproductive capacity).

a. **Explain the modeling of fish entrainment (up to 80%). Is there experimental data which supports linear rates of entrainment relative to flow?**

Response

a. Fish entrainment was considered by assessing the results of a literature review and was not modelled.

   Because of the unique nature of the Project design, and uncertainties in fish behavior (e.g., how resident fish distribute through a river or use refuge habitat such as flood plain areas during a flood), information to quantitively estimate fish displacement and subsequent entrainment in the diversion structure is not available. Modelling without this quantitative information as input would not provide meaningful results.

   The assessment uses the assumption that the proportion of the peak water volume diverted and the proportion of the resident fish community displaced and entrained during a flood has a 1:1 relationship (i.e., a 10% water diversion would result in a displacement and entrainment of 10% of the resident fish population; and 80% water diversion would result in a displacement and entrainment of 80% of the resident fish population). Due to the uncertainty discussed above, this assumption (i.e., there is a linear relationship between diversion rates and fish entrainment) cannot be tested using quantitative means. Therefore, a review of available literature was conducted to evaluate this assumption and summarize the reported nature of the relationship between water diversion and fish entrainment. The conclusion is that a 1:1 linear relationship is a conservative assumption (it likely overestimates that amount of entrainment). A discussion on the literature review that led to this conclusion follows.

Available literature on water diversions and fish entrainment was assembled using Google Scholar and reviewed. The relationship between fish entrainment and water diversion rates are not widely reported on in the literature (Moyle and Israel 2005). Many available papers do not consider entrainment rates or lack information relevant to evaluate entrainment rates or effects on fish populations. Eleven papers provide information to evaluate fish entrainment rates or comment on effects relevant to the Project (references summarized in Table 74-1). Of these 11 papers, nine were studies of irrigation diversions and two were studies of hydroelectric facilities.

In general, the authors found fish entrainment increases with water diversion volume (Spindler 1955; Sechrist and Potak Zehfuss 2010; Walters et al. 2012; Mathur et al. 2018); this relationship appears stronger at lower river flows (Mussen et al. 2013). Even though some authors reported a strong relationship between % of fish entrained and % of discharge diverted, there was always less than a 1:1 relationship between fish entrained and water diverted from a river. This suggests the 1:1 relationship used to assess effects to fish entrainment in the EIA is conservative (overestimates the effect).

Several of the studies reported entrainment rates for diversions occurring over a long period of time (e.g., irrigation season of four to five months and/or entrainment rates for an extended river reach with several diversions). Few authors reported on an entrainment rate for a single diversion site during a short-term event (e.g., period of a few days). Post et al. (2006) reported entrainment rates for salmonids in the Bow River at Carseland weir and irrigation diversion gate ranging from less than 1% over an irrigation season. Walters et al. (2012) reported entrainment of migrating chinook salmon smelt in a heavily diverted river (i.e., numerous diversion gates along the river) to be greater than 70% with a probability of 4% entrainment at any one diversion gate.

The proportion of resident fish displaced and entrained in the off-stream reservoir is difficult to predict based on this information. The amount of water diverted from Elbow River may be proportionally high, but for a relatively short period of time compared to durations reported in the literature. Peak diversion rates from Elbow River for each flood scenario are as follows:

- design flood
  - Up to 52% of flow diverted during peak discharge (3.75 days total time for diversion).
  - 600 m^3/s flow diverted as Elbow River flows increase up to an instantaneous peak discharge of 1,159 m^3/s.
- 1:100 year flood
  - Up to 78% of flow diverted during peak discharge (1.8 days total diversion time).
  - 600 m^3/s flow diverted as Elbow River flows increase up to an instantaneous peak flow of 765 m^3/s.

- 1:10 year flood
  - Up to 20% of flow diverted during peak discharge (0.38 days total diversion time).
  - 40 m^3/s flow diverted as Elbow River flows increase up to an instantaneous peak flow of 200 m^3/s.

The proportion of the Elbow River flow diverted is predicted to vary from zero to 20% of peak discharge for the 1:10 year flood, to 78% of peak discharge for the 1:100 year flood. These diversions are much higher than the diversion rates reported for single diversions (i.e., irrigation gates) in the literature (Table 74-1); however, they are also much shorter in duration than river diversions reported in the literature. During low flow periods in Bow River (i.e., late July through early October) in 2003, between 30% and 45% of the river discharge was diverted (and only 1% of fish entrained) at the Carseland weir diversion gate (Poste et al. 2006).

Post et al. (2006) reported fish entrainment rates in the Carseland weir diversion gate on Bow River to be less than 1% for salmonids (greater than 150 mm fork length) during the 2003 irrigation season (i.e., April to October; Table 74-2). Smaller fish were entrained at higher rates, especially for mountain whitefish. However, smaller fish make up a larger proportion of the population. Bow River population estimates for smaller fish were not available and, therefore, small fish entrainment rates were not calculated.

Considering the proportion of Elbow River flow predicted to be diverted during a flood (as discussed above) for a duration of less than four days, the proportion of resident Elbow River fish population entrained during a flooding event will be considerably less than that reported in Poste et al. (2006), wherein diversion and fish entrainment were considered over several months.

In summary, entrainment rates reported in the literature are lower than the diversion rates discussed above (i.e., less than 1:1). The diversion rates studied in the literature are generally lower than the proposed diversion rates for the Project and, the length of time for the diversion are much longer (i.e., months vs. days) in the previous studies. However, based on the work by Post et al. (2006), the proportion of the resident Elbow River fish population entrained in the diversion inlet will likely be less than 1% for fish that are greater than 150 mm long. If mortality of entrained fish is high, 1% of the population would be lost. The number of entrained small fish reported by Post et al. (2006) is higher than larger fish; however, the proportion of the overall resident fish population comprised of small fish cannot be calculated from this data.

AEP will apply an adaptive management approach to operating the reservoir. A fish monitoring plan is being developed to monitor fish health and fish populations during flood operations (as described in responses to NRCB Question 31 and AEP Question 77). The monitoring information will be used to inform actions to maintain fish population as developed under the *Fisheries Act* Authorization and offsetting plan (as described in the response to AEP Question 71).

Table 74-1 Summary of Stream Diversion and Entrainment Rates in Available and Relevant Literature

Reference	Diversion type	Drainage	Entrainment Rate	Conditions
Bahn 2007	Irrigation Diversions (multiple diversions)	Bitterroot River (MT): Lost Horse Creek Tin Cup Creek	• 2% to 3% of all trout sp. in basin.	• Entrainment significantly associated with: – discharge – upstream gradient – discharge ratio – length of irrigation season – temperature – diversion dam height – angle with downstream, thalweg
Carlson and Rahel 2007	Irrigation Diversions	Smith's Fork River Basin (WY)	• Bonnyville cutthroat trout (*Oncorhynchus clarkii*)– 1.2% to 3.3% entrainment rate. • Brown trout (*Salmo trutta*) – 0.4% to 1.2% entrainment rate (fish greater than 150 mm TL).	• Fish migrating (e.g., for spawning) during diversion are most susceptible to entrainment opposed to those not in their migration period.
Fincel et al. 2016	Hydro Dam	Missouri River (SD) Lake Oahe Dam	• Estimated entrainment rates for Rainbow Smelt (*Osmerus mordax*): • Summer 1997 – 439×10^6 Rainbow Smelt • Summer 1998 – 4×10^6 Rainbow Smelt • Summer 1999 – 2×10^6 Rainbow Smelt • Summer 2011 – (flood occurred) – 433×10^6 age-0 Rainbow Smelt – 231×10^6 adult Rainbow Smelt	• Entrainment highest during PM light time period (15:00 to 21:00 hours). • Entrainment rates for normal and high flows through a hydroelectric dam over a season.

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Table 74-1 Summary of Stream Diversion and Entrainment Rates in Available and Relevant Literature

Reference	Diversion type	Drainage	Entrainment Rate	Conditions
Mathur et al. 2018	Pumping Facility	Susquehanna River (MD) Conowingo Pond - river impoundment	• American Shad (*Alosa sapidissima*) entrained in month of October: – 3.5% of juveniles – 3.9% adults	• Intake velocity 0.2 m/s to 0.9 m/s. • Highest entrainment rate during highest pumping rate, between 23:00 and 06:00 hours. • River flow - 650 m^3/s to 2,775 m^3/s. • Pumping Flow 113 m^3/s to 907 m^3/s.
McDougall et al. 2013	Run of the River Hydroelectric Facility	Winnipeg River (MB) between Pointe du Bois and Slave Falls	• Entrainment rate for tagged Lake Sturgeon (*Acipenser fulvescens*): – 27% of sub-adults – 8.7% of adults	• Winnipeg River mean flows 869 m^3/s (range 100 m^3/s to 2,600 m^3/s). • Entrainment rates for flows over a 10-month period through a run of the river hydroelectric facility (i.e., 100% flow through the facility).
Mussen et al. 2013	--	Laboratory experiment on irrigation pipe inlets	• Juvenile (12 cm to 14 cm) Chinook salmon (*Oncorhynchus tshawytscha*). • An increase in diversion rate (0.42 m^3/s to 0.57 m^3/s [35.7%]) resulted in an increase in entrainment rate from 0.9% to 1.7%).	• Simulated river current velocity – 0.15, 0.38, and 0.61 m/s. • Diversion velocity (0.46 m diameter pipe) at 0.15, 0.61 m/s. • Clear, turbid water and night treatments. • Threshold of risk to fish with within 36 cm of pipe intake with velocity of 0.74 m/s at pipe inlet. • Entrainment was highest under treatment combinations with lowest stream flow velocities and highest diversion rates.

Table 74-1 Summary of Stream Diversion and Entrainment Rates in Available and Relevant Literature

Reference	Diversion type	Drainage	Entrainment Rate	Conditions
Nobriga et al. 2004	Irrigation Diversion Pipes	Sacramento River Delta (CA)	• Entrainment rate included 23 fish entrained under screened treatment compared to 8,501 fish under unscreened treatment (all under 45 mm). Fish sp. included: – Threadfin shad (*Dorosoma petenense*) – Inland silverside (*Menidia beryllina*) – Striped bass (*Morone saxatilis*) – Delta smelt (*Hypomesus transpacificus*)	• Three diversion pipes 61 cm diameter. • Study in the delta of the Sacramento river affected by tidal movement. • 34 to 38 hours of monitoring entrainment the second week of July in 2000 and 2001.
Post et al. 2006	Irrigation Diversion	Bow River AB (Carseland Canal)	• Estimated Entrainment Rates over the 2003 irrigation season April to October: – Rainbow Trout: 3,996 fish entrained (42% >155 mm) – Brown Trout: 664 fish entrained (17% >150 mm) – Mountain Whitefish: 93,850 fish (0.5% >150 mm)	• During 2003 Bow River discharge was: – approximately 50 m^3/s in May – peaked at approximately 200 m^3/s in June – decreased to approximately 100 m^3/s in July – just over 50 m^3/s by October • Diversion rate 1.4 m^3/s to 37.7 m^3/s and represented a considerable proportion of river flow from July through October 2003 (between 30% and 45%).

Table 74-1 Summary of Stream Diversion and Entrainment Rates in Available and Relevant Literature

Reference	Diversion type	Drainage	Entrainment Rate	Conditions
Sechrist and Potak Zehfuss 2010	Irrigation Diversion	Sun River (MT)	• Entrainment rate of larger trout (>200 mm) – 2003 o Brown Trout 14.4 % o Rainbow Trout 4.3% – 2004 o Brown Trout 16.0 % o Rainbow Trout 2.6%	• Number of fish entrained related to proportion of river diverted. • 2003 diversion rate between 0.6 m^3/s to 6.7 m^3/s. • 2004 diversion up to 7.4 m^3/s. • Sun River discharge both years peaked at 39 m^3/s and dropped to 1.5 m^3/s for remainder of the season.
Spindler 1955	Irrigation Diversion	West Gallatin River (MT)	• Relationship between fish entrainment and volume of flow was expressed in the following regressions: – 1951 season: Y=10.2+0.429X – 1952 season: Y=3.0+0.67X Y=loss of legal sized game fish. X =volume of canal flow (cubic feet per second).	• Loss of legal sized fish was proportional to the volume of flow in irrigation canal.
Walters et al. 2012	Watershed Wide; Multiple Irrigation Diversions	Lemhi River (ID)	• Estimated entrainment of Chinook salmon (out migrating smolts) throughout the watershed was 71%. • Probability of entrainment at an individual diversion was 4% under high stream flow conditions.	• Watershed diversion generally less than 50% of flow. • Median stream flow conditions during study. • Entrainment probability was linear and somewhat less than one (i.e., probability of entrainment approx. 0.15 with 20% diversion to 0.6 with 80% diversion).

Table 74-2 Salmonid Fish Entrainment Rates in the Carseland Weir Diversion Gate on Bow River, April to October 2003

Fish Species	Estimated Population (>150 mm)	Total Fish Entrained	Entrainment Rate (fish >150 mm)	Month of Maximum Entrainment
Rainbow Trout (*Oncorhynchus mykiss*)	186,847	1,683 (42%) >150 mm 2,313 (58%) <150 mm	0.90%	August
Brown Trout (*Salmo trutta*)	25,001	116 (17%) >150 mm 548 (83%) <150 mm	0.46%	September
Mountain Whitefish (*Prosopium williamsoni*)	301,173	430 (0.5%) >150 mm 93,420 (99.5%) <150 mm	0.14%	September
SOURCE: Post et al. 2006				

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Question 75

Supplemental Information Request 1, Question 351, Pages 5.248-5.250
Volume 3B, Section 8.2.4.3, Page 8.17
Volume 3B, Section 6.4.3.1, Table 6-6, Page 6.2B

Alberta Transportation predicts that effects on fish would not meet the threshold that is considered serious harm to fish because fish rescues would be conducted to remove any stranded fish, eliminating mortality.

In general, rescuing stranded fish from pools in reservoirs is expensive, ineffective, and sometimes cannot be undertaken due to risks to human safety (i.e. inaccessibility due to mud). There are assumptions that very few or no fish will be stranded and that fish rescue is safe, feasible, and effective. Neither of these assumptions are likely correct based upon experience (i.e. periodic fish stranding in the Ghost Reservoir).

In addition, the response provided has not been answered sufficiently. It does not address potential harm to fish due to timing of sediment release, nor does it consider the effect of the sediment on entrained fish. It also does not address the potential impacts of failure to rescue stranded fish, which is not something considered in the document (but which commonly occurs in other dams during draining for maintenance work, i.e. fish cannot be reached safely to rescue them, and perish).

a. **Explain how this mortality risk can be classified as not significant given that mitigation relies on locating and rescuing an unknown number of fish by hand with an unspecified work force capacity working in a short time window during which reservoir water quality and capacity will support fish.**

b. **Estimate the mortality of fish due to dam operations, and evaluate the potential population level effects of this mortality.**

c. **Develop a mitigation plan to address mortality from stranding.**

d. **Develop a monitoring plan to assess the impact of dam operations on fisheries populations.**

Response

This response will be included in a future filing.

Question 76

Supplemental Information Request 1, Question 353a, Page 5.257

Alberta Transportation states that monitoring would be conducted from shore.

This question has not been answered sufficiently and does not address what will happen if there are problems with operations or during periods when flows are low, or if v-weirs sustain damage and need maintenance.

a. Describe and explain what monitoring of fish passage will entail including frequency, time of year, and techniques.

b. Develop mitigation plans focused on the potential failure of fish passage.

Response

This response will be included in a future filing.

Question 77

Supplemental Information Request 1, Question 354, Pages 5.259-5.260

Alberta Transportation states that monitoring would be conducted from shore.

This question has not been answered sufficiently. Monitoring fish from shore will not identify signs of stress, injury, or mortality.

a. Describe monitoring at the low level outlet and in the reservoir to identify signs of stress.

b. Develop a monitoring plan for the monitoring of fish conditions for the fish returning to the Elbow River using methods acceptable in fisheries science.

c. Will any monitoring be undertaken in the Elbow River to ascertain whether fish swimming out of the reservoir are exhibiting signs of stress or mortality after returning to the flowing watercourse? If monitoring is to be undertaken describe the monitoring plan that will be in place. If no monitoring is to be undertaken justify and explain the rationale behind not monitoring fish in the Elbow River to determine if fish are exhibiting signs of stress or mortality after returning to the flowing watercourse.

Response

This response will be included in a future filing.

Question 78

Supplemental Information Request 1, Question 356a, Page 5.261

Alberta Transportation states that the impacts of dam construction would be minimal in regard to affecting fish habitat.

This question has not been answered sufficiently as it does not account for potential negative impacts to fish movement or fish habitat during dam construction and operation.

a. **Provide an update to the summary table which shows the full range of magnitude for potential effects of the dam on fish habitat.**

b. **Describe what mitigation measures will be implemented to minimize impacts to habitat and fish movement during construction. The mitigation measures should take into account the construction activities and duration.**

Response

a-b. Table 78-1 presents an updated full range of magnitude for potential effects of the Project on fish habitat. The table also includes a list of mitigation measures to reduce effects on fish habitat and fish movement.

Table 78-1 Itemized Summary of Environmental Effects Assessment as it Relates to Fish and Fish Habitat

	Physical Activities	Potential Effect	Description of effect	Mitigation	Residual Effect	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological or Socio-economic Context	Timing	Significance of Residual Effect
Project Phase: Construction														
Construction	Instream construction (comprises temporary activities)	Change in fish habitat	Instream work can result in temporary disturbances to fish habitat.	• Construction activities near water will be planned and completed in the dry and isolated from watercourses to prevent materials such as paint, primers, blasting abrasives, rust solvents, degreasers, grout, other chemicals or other deleterious materials from entering the watercourse. • Clearing of riparian vegetation will be kept to a minimum. • Erosion and sediment control measures will be installed before starting work to prevent sediment from entering the water body. • Erosion and sediment control measures will be inspected daily and maintained during construction. • Erosion and sediment control measures will be repaired immediately if damage occurs. • Erosion and sediment control measures will be maintained and monitored until vegetation has become sufficiently re-established. • Works in water will be timed with respect to the restricted activity periods (RAPs) wherever possible. For Elbow River, the RAP is May 1 to July 15 and September 16 to April 15. Conditions of and use of restricted activity periods will be provided within further Project permitting and authorization under the *Fisheries Act*. The Elbow River RAP will be applied as an avoidance and mitigation measure. • Construction equipment will be mechanically sound with no oil leaks, fuel or fluid leaks. Equipment will be inspected daily and immediately repair any leaks. • A minimum 100 metre setback distance will be maintained between stored fuels and lubricants and rivers, streams and surface water bodies.	The Project has the potential to change fish habitat during instream construction because equipment will be working instream and access to habitat will be temporarily disturbed through isolation, diversion, and excavation works. Instream work can result in disturbance to the water quality, substrate availability, and flows that subsequently effect fish habitat. A change in fish habitat, and subsequently a change in fish distribution and behaviour. Residual effects related to instream construction are limited to the seasons where construction activities are scheduled to occur, and instream work will be scheduled to avoid the RAP of Elbow River. Residual effects with respect to a change in fish habitat are considered low in magnitude and are temporary in nature. Mitigation measures will be implemented to reduce the instream footprint to the extent possible, and work will be monitored to reduce the potential effects to fish habitat.	A	L	PDA	ST	S	IR	U	S/R	The residual effects on fish habitat as a result of instream construction are unlikely to pose a long-term threat to the persistence or viability of a fish species, including Species at Risk, in the RAA. Project related changes or loss of fish habitat must be offset to maintain the sustainability of resident fish populations. With the application of mitigation measures, and offsets, residual effects on fish habitat are predicted to be not significant.

Table 78-1 Itemized Summary of Environmental Effects Assessment as it Relates to Fish and Fish Habitat

	Physical Activities	Potential Effect	Description of effect	Mitigation	Residual Effect	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological or Socio-economic Context	Timing	Significance of Residual Effect
Construction (continued)	Instream construction (comprises temporary activities) (cont'd)	Change in fish habitat (cont'd)	Instream work can result in temporary disturbances to fish habitat. (cont'd)	• Machinery will arrive on site in a clean condition and be maintained free of fluid leaks, invasive species, and noxious weeds. • Personnel will be qualified to handle construction equipment fuels and lubricants to perform repairs. • Service vehicles will carry fuel spill clean-up materials. • Containment berms and impermeable liners will be installed around fuel and lubricant storage tanks. • Structures will be designed so that storm water runoff and wash water from the access roads, side slopes, and approaches will be directed into a retention pond or vegetated area to remove suspended solids, dissipate velocity, and prevent sediment and other deleterious substances from entering the watercourse. • Where instream works are required, non-toxic and biodegradable hydraulic fluids will be used in machinery. • Measures for managing water flowing onto the site (e.g., silt fences, turbidity barriers, pumping/diverting water to a vegetated area, constructing a settling basin, or other filtration system), as well as water being pumped/diverted from the site, will be implemented such that sediment is filtered out before the water enters a waterbody). • Whenever possible, machinery will be operated on land above the high-water mark in a manner that reduces disturbance to the banks and bed of the watercourses. • Isolation materials will be designed to reduce disturbance of the bed and banks of Elbow River and other watercourses. • The location of any instream works will be isolated from the watercourses using silt fences, temporary diversions, turbidity barriers, and clean granular berms.										

Table 78-1 Itemized Summary of Environmental Effects Assessment as it Relates to Fish and Fish Habitat

	Physical Activities	Potential Effect	Description of effect	Mitigation	Residual Effect	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological or Socio-economic Context	Timing	Significance of Residual Effect
Construction (continued)	Instream construction (comprises temporary activities) (cont'd)	Change in fish habitat (cont'd)	Instream work can result in temporary disturbances to fish habitat. (cont'd)	• Building material used in watercourses (e.g., concrete, silt fences, turbidity barriers, and containment berms) will be used to prevent the release or leaching of substances that may be deleterious to fish into the water. • Before isolation and dewatering works commence, a qualified environmental professional will be retained to obtain applicable permits for relocating fish and to capture any fish trapped within an isolated/enclosed area at the work site and safely relocate them to an appropriate location in the same waters. • To allow for fish passage and construction of the structures in the dry, Elbow River will be temporarily diverted, and flows will be maintained downstream by the construction of a temporary bypass channel. • Excavated materials and debris will be stockpiled above the highwater mark so as to not enter the watercourse. Silt fences will be used to contain soil erosion. • During instream work, large woody debris pieces such as rootballs and logs over 50 cm in diameter, will be retained and relocated in the river downstream of the structure. • Clean granular fill with less than 5% fines passing the 80 mm sieve size will be used for instream work such as cofferdams, access ramps, river channel diversions. Fine grained soils may be used, provided only clean granular fill is exposed to the river at any time during construction and restoration operations. • Sediment and erosion control devices will be constructed to withstand anticipated flows during construction. If necessary, the outside face of granular berms may be lined with heavy polyplastic to make them impermeable to water.										

Table 78-1 Itemized Summary of Environmental Effects Assessment as it Relates to Fish and Fish Habitat

	Physical Activities	Potential Effect	Description of effect	Mitigation	Residual Effect	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological or Socio-economic Context	Timing	Significance of Residual Effect
Construction (continued)	Instream construction (comprises temporary activities) (cont'd)	Change in fish habitat (cont'd)	Instream work can result in temporary disturbances to fish habitat. (cont'd)	• The top bed substrate from a wetted channel will be stripped and stockpiled for later use as the top layer of reclaimed instream substrate to improve the recolonization rate and maintain average mobile substrate sizes. • Rootwads and large boulders that must be removed will be stored on-site for subsequent placement on reclaimed instream areas for cover habitat or for bank protection. • Water intakes pipes will be screened to prevent entrainment or impingement of fish. Entrainment occurs when a fish is drawn into a water intake and cannot escape. Impingement occurs when an entrapped fish is held in contact with the intake screen and is unable to free itself. Screens will comply with DFO's Freshwater Intake End-of-Pipe Fish Screen Guidelines. • Sediment-laden dewatering discharge will be pumped into a vegetated area or settling basin to allow sediment to settle out before returning it to the water body. Silt fences, turbidity barriers and clean granular berms will be used to contain the sediment and other deleterious substances and to prevent it from entering a watercourse or water body. • Energy dissipaters will be used at pump outlets to prevent erosion. • Pump discharge area(s) will be isolated to prevent erosion and the release of suspended sediments downstream. Any sediment build-up will be removed when the work is completed. • TSS levels will be controlled and reduced using silt fences and turbidity barriers so that water quality from care of water system discharges is made equal to or better than the initial water quality. TSS levels will be monitored by carrying out frequent water quality testing. • A monitoring program will be undertaken to identify if fish passage is impeded for migratory salmonids or movement of other fish species.										

Table 78-1 Itemized Summary of Environmental Effects Assessment as it Relates to Fish and Fish Habitat

	Physical Activities	Potential Effect	Description of effect	Mitigation	Residual Effect	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological or Socio-economic Context	Timing	Significance of Residual Effect
Construction (continued)	Instream construction (comprises temporary activities) (cont'd)	Change in fish habitat (cont'd)	Instream work can result in temporary disturbances to fish habitat. (cont'd)	• Accumulated sediment and spoil build up within the isolated areas will be removed prior to removal of the isolation barriers. • When removing the isolation barriers, the downstream isolation barriers will be gradually removed first so as to equalize water levels inside and outside of the isolated area and to allow suspended sediments to settle prior to removing the upstream isolation materials. • The cleaning and removal of debris and sediment from sediment and erosion control devices will be conducted in a manner that will prevent materials from entering the water body. • Stream bank and bed protection methods (e.g., swamp mats, pads) will be used if rutting is likely to occur during access to the bed and shore. Temporary access structures will be used where steep and highly erodible banks are present. • After construction, disturbed areas will be stabilized and reclaimed. • Boulders will be added in the channel to increase the bed roughness immediately downstream of the diversion structure, which will increase water depths and reduce velocities to provide cover and facilitate fish passage. • Boulder V-weir structures will be constructed in the channel downstream of the gates to provide slower velocity and deeper resting zones and facilitate fish passage. • Fertilization of reclaimed areas in the immediate vicinity of a watercourse will not be allowed unless approved by DFO and AEP. • Streambanks and approach slopes will be revegetated using an appropriate native seed mix or erosion control mix. • Non-biodegradable erosion and sediment control materials will be removed once the site is stabilized.										

Table 78-1 Itemized Summary of Environmental Effects Assessment as it Relates to Fish and Fish Habitat

	Physical Activities	Potential Effect	Description of effect	Mitigation	Residual Effect	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological or Socio-economic Context	Timing	Significance of Residual Effect
Construction (continued)	Instream construction (comprises temporary activities) (cont'd)	Change in fish habitat (cont'd)	Instream work can result in temporary disturbances to fish habitat. (cont'd)	• Herbicide use in the immediate vicinity of a watercourse will not be allowed unless approved by DFO and AEP. Weeds will be controlled during construction through multiple measures such as herbicide, mowing, wicking, and hand picking. After construction, disturbed areas will be stabilized and reclaimed.										
		Change in water quality	Instream work introduces a change in water quality as a result of increased sedimentation during construction.	• See mitigation above for "Instream Construction – Change in Fish Habitat". • See Alberta Transportation's response to Round 1 AEP IR 302, Appendix 302-1: Draft Surface Water Monitoring Plan.	The construction of the diversion structure (and associated temporary diversion channel) has the potential to change water quality temporarily by increasing suspended sediments for the duration of planned in-water activities. Change in water quality can subsequently affect fish behaviour and physiology. Residual effects related to instream construction are limited to the seasons where construction activities are scheduled to occur and residual effects are considered low in magnitude and temporary in nature. Total suspended solids will be monitored throughout instream work.	A	L	LAA	ST	S	R	U	S/R	The residual effects on water quality as a result of instream construction are unlikely to pose a long-term threat to the persistence or viability of a fish species, including Species at Risk, in the RAA. With the application of mitigation measures, residual effects on water quality are predicted to be not significant.
Project Phase: Dry Operation														
Operation	Maintenance (debris management, structural repair)	Change in fish habitat	Maintenance and repairs, or debris removal could require instream work. Instream work can result in temporary disturbances to fish habitat.	• See mitigation above for "Instream Construction – Change in Fish Habitat". • Where debris removal from the structures is required, debris removal will be timed to avoid disruption to sensitive fish life stages (i.e., outside the RAP), unless the debris and its accumulation is immediately threatening to the integrity of the structure or relates to an emergency (i.e., risk of structure failure).	The Project has the potential to change fish habitat during maintenance activities because equipment will be working instream and access to habitat will be temporarily disturbed through isolation, equipment access, and debris removal.	A	L	PDA	ST	S	IR	U	S/R	The residual effects on fish habitat as a result of instream work (associated with maintenance) are unlikely to pose a long-term threat to the persistence or viability of a fish species, including Species at Risk, in the RAA. With the application of mitigation measures, residual effects on fish habitat are predicted to be not significant.

Table 78-1 Itemized Summary of Environmental Effects Assessment as it Relates to Fish and Fish Habitat

	Physical Activities	Potential Effect	Description of effect	Mitigation	Residual Effect	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological or Socio-economic Context	Timing	Significance of Residual Effect
Operation (continued)	Maintenance (debris management, structural repair) (cont'd)	Change in fish habitat (cont'd)	Maintenance and repairs, or debris removal could require instream work. Instream work can result in temporary disturbances to fish habitat. (cont'd)		Instream work can result in disturbance to the water quality, substrate availability, and flows that subsequently effect fish distribution and behaviour. Residual effects related to instream construction are limited to the seasons where maintenance activities are scheduled to occur. Instream work will be scheduled to avoid the RAP of Elbow River whenever possible. Residual effects are considered low in magnitude and are temporary in nature. Mitigation measures will be implemented to reduce the instream footprint to the extent possible, and work will be monitored to reduce the potential effects to fish habitat.									
		Change in water quality	Instream work introduces a change in water quality as a result of increased sedimentation during maintenance and repairs.	• See mitigation above for "Instream Construction – Change in Fish Habitat". • See Alberta Transportation's response to Round 1 AEP IR302, Appendix 302-1: Draft Surface Water Monitoring Plan.	Maintenance activities during dry operation will include instream work that has the potential to change water quality temporarily. Change in water quality can subsequently affect fish behaviour and physiology. Residual effects related to maintenance are limited to the seasons where instream work is scheduled to occur. Activities will be planned to avoid the RAP of Elbow River to mitigate potential effects related to a change in water quality. Residual effects are considered low in magnitude and are temporary in nature. Total suspended solids will be monitored throughout instream work.	A	L	LAA	ST	S	R	U	S/R	The residual effects on water quality as a result of instream work (associated with maintenance) are unlikely to pose a long-term threat to the persistence or viability of a fish species, including Species at Risk, in the RAA. With the application of mitigation measures, residual effects on water quality are predicted to be not significant.

Table 78-1 Itemized Summary of Environmental Effects Assessment as it Relates to Fish and Fish Habitat

<table>
<tr><th></th><th>Physical Activities</th><th>Potential Effect</th><th>Description of effect</th><th>Mitigation</th><th>Residual Effect</th><th>Direction</th><th>Magnitude</th><th>Geographic Extent</th><th>Duration</th><th>Frequency</th><th>Reversibility</th><th>Ecological or Socio-economic Context</th><th>Timing</th><th>Significance of Residual Effect</th></tr>
<tr><td>Operation (continued)</td><td>Permanent footprint in the Elbow River</td><td>Change in fish habitat</td><td>The footprint of the spillway, gates, and diversion inlet will permanently remove fish habitat from Elbow River.</td><td>A fish habitat offsetting plan is being prepared to mitigate habitat loss that will occur as a result of the Project footprint (presented below):
<table>
<tr><th>Project Component</th><th>Habitat Area (m^2)</th><th>Habitat Type[2]</th></tr>
<tr><td colspan="3">Temporary Habitat Alteration</td></tr>
<tr><td>Berms to isolate channel</td><td>4,744</td><td>• riffle, Run (R2 and R3) and gravel bar units
• potential rearing habitat</td></tr>
<tr><td>Dry working space within the channel[1]</td><td>15,002</td><td>• riffle, rapid, channel snye, and gravel bar units
• potential rearing, spawning habitat</td></tr>
<tr><td>sub-total</td><td>19,746</td><td></td></tr>
<tr><td colspan="3">Permanent Habitat Alteration</td></tr>
<tr><td>V-weir fish passage structures</td><td>598</td><td>• run (R2 and R3) and riffle units
• potential spawning gravel habitat</td></tr>
<tr><td>Bank armour</td><td>1,458</td><td>• gravel bar, bank, run (R2) units
• potential limited bank cover and feeding habitat</td></tr>
<tr><td>sub-total</td><td>2,056</td><td></td></tr>
</table></td><td>The Project will result in habitat alteration and destruction associated with the permanent footprint in Elbow River. Alteration and loss of habitat will change fish habitat that is available in Elbow River for fish species to carry out spawning and rearing life history requirements. There will be a habitat offsetting plan that endeavours to mitigate the loss associated with the Project by offering fish habitat or a benefit to the fishery through separate works.
Residual effects are considered low in magnitude because the footprint of the structures will be offset through a benefit to the fishery.</td><td>A</td><td>L</td><td>PDA</td><td>P</td><td>S</td><td>I</td><td>U</td><td>S/R</td><td>The residual effects on fish habitat as a result of the placement of structures in water are unlikely to pose a long-term threat to the persistence or viability of a fish species, including Species at Risk, in the RAA. With the application of mitigation measures, including a habitat offsetting plan (and associated habitat monitoring for regulatory compliance), residual effects on fish habitat are predicted to be not significant.</td></tr>
</table>

Table 78-1 Itemized Summary of Environmental Effects Assessment as it Relates to Fish and Fish Habitat

	Physical Activities	Potential Effect	Description of effect	Mitigation	Residual Effect	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological or Socio-economic Context	Timing	Significance of Residual Effect
Operation (continued)	Permanent footprint in the Elbow River (cont'd)	Change in fish habitat (cont'd)	The footprint of the spillway, gates, and diversion inlet will permanently remove fish habitat from Elbow River. (cont'd)	**Habitat Destruction** Debris deflector – 2,766 – • gravel bar and bank units • minimal habitat only during freshet Service spillway (with Obermeyer gates), stilling basin and bank modification – 2,970 – • run (R2 and R3), gravel bar and bank units • potential rearing habitat; gravel bar and bank habitat provide minimal high-water habitat Cut-off of unnamed channel – 300 – • shallow riffle, run, pool units • temporary habitat and generally poor for all life stages *sub-total* – *6,036* NOTES: 1 a diversion channel around the workspace of approximately 19,080 m² will be constructed to maintain Elbow River flows and fish passage; this area is not included in the habitat area calculations. 2 habitat types reflect water flows during late summer air photos.										

Table 78-1 Itemized Summary of Environmental Effects Assessment as it Relates to Fish and Fish Habitat

	Physical Activities	Potential Effect	Description of effect	Mitigation	Residual Effect	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological or Socio-economic Context	Timing	Significance of Residual Effect
Operation (continued)	Permanent footprint in the Elbow River (cont'd)	Change in fish movement	The instream structures of the Project have the potential to impede fish passage.	• The Project has been designed to align with industry-standard fish passage design considerations that are outlined in Katapodis' Introduction to Fishway Design (1992). • Fish passage design relied on an analysis of the $3Q_{10min}$ to determine flows and depth that are acceptable for bull trout, which are known to migrate extended distances in the LAA. The Katapodis (1992) design criteria were used to develop the following design mitigation: – The spillway gates and stilling basin and are designed to provide adequate flow and water depth to facilitate resident fish passage under low-flow conditions. – Fish passage structures (i.e., v-weirs) will be constructed in the thalweg below the spillway gates and stilling basin to provide a "stepped" upstream approach to the gates under low flow condition. Each v-weir provides a pool adequate for resident fish to reach burst speed to jump and pass the weir. – The Project is designed to facilitate elevated river flows (i.e., up to 160 m^3/s) through the spillway gates in a manner that maintains a maximum velocity that is suitable to pass fish.	The Project has the potential to change fish movement through the introduction of permanent structures that pose a physical barrier to upstream fish passage, or a behavioural change as a result of the visual changes to the riverbed profile. A change to fish movement could have subsequent effects on fish distribution in Elbow River. The Project has been designed to reduce potential effects associated with a change to fish movement through design features that reduce physical barriers (i.e., depth, velocity) to fish. The fish passage design aligns with physical conditions that would be present in Elbow River in the absence of the Project. The residual effect of the instream structures on fish passage is neutral in direction, low in magnitude, restricted to the PDA, permanent in duration, and continuous in frequency.	N	L	PDA	P	C	I	U	S/R	The residual effects on fish passage as a result of the placement of instream structures in Elbow River are unlikely to pose a long-term threat to the persistence or viability of a fish species, including Species at Risk, in the RAA. With the application of mitigation measures, including fish passage design features, residual effects on fish movement are predicted to be not significant.
Project Phase: Flood Operation and Post-Flood Operation														
Flood Operation and Post-Flood Operation	Flood water diversion	Change in flow	A change in flow as a result of a reduction in maximum flood flows will occur with the Project. A change in flood flows will influence channel morphology and bedload movement, which could alter substrate composition, cover, fish habitat quality in Elbow River downstream of the Project.	• A habitat offsetting plan is currently being prepared to mitigate potential changes to fish habitat. Furthermore, a post-construction habitat monitoring plan will be implemented to monitor habitat in Elbow River as a result of flood operation. This habitat monitoring plan will evaluate habitat quality in relation to pre-construction conditions to determine whether the offsetting measures align with the changes that are observed in habitat following flood operation.	Channel-forming flows of 160 m^3/s will be maintained in Elbow River. Therefore, fish habitat will be maintained in a natural manner. The residual effect of change in flow (and subsequent change in channel morphology) is neutral in direction, low in magnitude, restricted to the LAA, long-term in duration, and irregular in frequency.	N	L	LAA	LT	IR	I	U	S	The residual effects on flow as a result of the reduction in maximum flood flows in Elbow River are unlikely to pose a long-term threat to the persistence or viability of a fish species, including Species at Risk, in the RAA. A habitat offsetting plan will also consider the alteration of downstream habitat as a result of the Project. including fish passage design features. Residual effects on flows are predicted to be not significant.

Table 78-1 Itemized Summary of Environmental Effects Assessment as it Relates to Fish and Fish Habitat

	Physical Activities	Potential Effect	Description of effect	Mitigation	Residual Effect	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological or Socio-economic Context	Timing	Significance of Residual Effect
Flood Operation and Post-Flood Operation (continued)	Flood water diversion (cont'd)	Change in fish movement	Fish have the potential to be swept into the diversion inlet during flood operation, and fish may not be able to access areas upstream of the Project during flood operations.	• Mitigation is not proposed to prevent fish from becoming entrained in the reservoir; options of screening the intake would conflict with the flood protection objectives of the Project.	The Project has the potential to change fish movement during flood operations because the spillway gates will restrict fish movement to upstream areas. Resident fish will likely find refuge during a flood and will not be migrating or moving upstream at this time. The spillway gates will hinder upstream fish passage past the Project for the duration the gates are up during a flood (e.g., up to 3.75 days for a design flood). The residual effect of change to fish movement during flood operations is considered moderate in magnitude due to the natural behavior of fish during floods. Residual effects are restricted to the LAA, short-term in duration, and irregular in frequency. Design mitigation has been included to mitigate the potential effects to fish that are entrained, and a Fish Rescue and Fish Monitoring Plan included in response to NRCB Question 31 (Appendix 31-1) will be implemented during operation to further mitigate potential effects to fish that are displaced into the diversion inlet.	A	M	LAA	ST	IR	R	U	S/R	The residual effects on fish movement as a result of flood operations (and potential for fish to become swept into the diversion inlet) are unlikely to pose a long-term threat to the persistence or viability of a fish species, including Species at Risk, in the RAA. With the application of mitigation measures, including a Fish Rescue and Fish Monitoring Plan, residual effects on fish movement are predicted to be not significant.

Table 78-1 Itemized Summary of Environmental Effects Assessment as it Relates to Fish and Fish Habitat

	Physical Activities	Potential Effect	Description of effect	Mitigation	Residual Effect	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological or Socio-economic Context	Timing	Significance of Residual Effect
Flood Operation and Post-Flood Operation (continued)	Flood water diversion (cont'd)	Fish entrainment	Fish have the potential to become entrained as they move through the diversion inlet and diversion channel into the reservoir.	• Mortality for fish displaced and entrained in the diversion inlet during a flood will be addressed through monitoring and fish rescue mitigations. • The diversion channel has been designed to accommodate fish passage; design mitigation includes appropriate channel configuration and grade to minimize the risk of stranding. • See mitigation above for "Flood Water Diversion – Change in Flow".	The residual effects of fish entrainment as a result of flood operations is adverse in direction, moderate in magnitude, restricted to the LAA, short-term in duration, and irregular in frequency. Design mitigation has been included to mitigate the potential effects to fish that are entrained, and a Fish Rescue and Fish Monitoring Plan included in response to NRCB Question 31 (Appendix 31-1) will be implemented during operation to mitigate the risk of fish becoming entrained as they move through the diversion channel, into the reservoir, and as they return into Elbow River upon reservoir drawdown.	A	M	LAA	ST	IR	R	U	S/R	The residual effects of fish entrainment as a result of flood operations are unlikely to pose a long-term threat to the persistence or viability of a fish species, including Species at Risk, in the RAA. With the application of mitigation measures, including a Fish Rescue and Fish Monitoring Plan, residual effects on fish entrainment are predicted to be not significant.
		Fish mortality	Fish have the potential to be injured or killed as they move through the inlet and diversion channel into the reservoir.	• See mitigation above for "Flood Water Diversion – Change in Flow".	The residual effects of fish mortality as a result of flood operations is adverse in direction, moderate in magnitude, restricted to the LAA, short-term in duration, and irregular in frequency. A Fish Rescue and Fish Monitoring Plan included in response to NRCB Question 31 (Appendix 31-1) will be implemented during flood and post-flood operations to further mitigate the risk of fish mortality as fish move through the diversion channel, reservoir, and are returned into Elbow River upon reservoir drawdown.	A	M	LAA	ST	IR	R	U	S/R	The residual effects of fish mortality as a result of flood operations are unlikely to pose a long-term threat to the persistence or viability of a fish species, including Species at Risk, in the RAA. With the application of mitigation measures, including a Fish Rescue and Fish Monitoring Plan (Appendix IR 31-1), residual effects on fish mortality are predicted to be not significant.

Table 78-1 Itemized Summary of Environmental Effects Assessment as it Relates to Fish and Fish Habitat

	Physical Activities	Potential Effect	Description of effect	Mitigation	Residual Effect	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological or Socio-economic Context	Timing	Significance of Residual Effect
Flood Operation and Post-Flood Operation (continued)	Water retention in the reservoir	Change in fish movement	Fish that are displaced into the reservoir during flood operations may not be able to carry out their life history requirements (e.g., migration for spawning) or find appropriate habitat (e.g., cover) for the duration of water retention in the reservoir.	• Design mitigation will reduce the risk of effects to fish to the extent possible for the duration of time that they are entrained in the reservoir: – The diversion channel and reservoir are designed to grades that convey reservoir water to the center of the reservoir and avoid isolated pooling where fish may be trapped. – The contours and elevations of the reservoir (i.e., bowl shape) will result in water pooling in the deeper central area of the reservoir; this will maintain an area of elevated water depths where fish will find more suitable refuge including lower temperatures and cover. – Fish rescue efforts will be increased to the extent possible when safe to do so by increasing manpower to staff multiple fish rescue teams. This added manpower will mitigate potential effects to fish by increasing fish rescue efforts and the rate of capture to the extent possible. – Water temperature will be monitored in the reservoir during reservoir drawdown; further details related to the monitoring efforts are in Alberta Transportation's response to Round 1 AEP IR 302, Appendix 302-1 Draft Surface Water Quality Monitoring Plan. • The design mitigation, and fish rescues stated above will reduce the potential effects on fish as a result of change in movement, change in water quality, and fish mortality as a result of the activity.	The Project has the potential to change fish movement through flood operation because fish that become entrained in the reservoir will not be able to move to access habitats that are required to carry out their life history requirements. The residual effects of change in fish movement as a result of water retention in the reservoir is adverse in direction, moderate in magnitude, restricted to the LAA, short-term in duration, and irregular in frequency. Design mitigation has been included to mitigate the potential effects to fish that are entrained, and a Fish Rescue and Fish Monitoring Plan included in response to NRCB Question 31 (Appendix 31-1) will be implemented during operation to mitigate the risk that fish become entrained as they move through the diversion channel, into the reservoir, and as they return into Elbow River upon reservoir drawdown.	A	M	LAA	ST	IR	R	U	S/R	The residual effects on fish movement as a result of water retention in the reservoir are unlikely to pose a long-term threat to the persistence or viability of a fish species, including Species at Risk, in the RAA. With the application of mitigation measures, including a Fish Rescue and Fish Monitoring Plan included in response to NRCB Question 31 (Appendix 31-1), residual effects on fish movement are predicted to be not significant.

Table 78-1 Itemized Summary of Environmental Effects Assessment as it Relates to Fish and Fish Habitat

	Physical Activities	Potential Effect	Description of effect	Mitigation	Residual Effect	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological or Socio-economic Context	Timing	Significance of Residual Effect
Flood Operation and Post-Flood Operation (continued)	Water retention in the reservoir (cont'd)	Fish mortality	Fish mortality may occur as a result of deteriorating water quality in the reservoir, injury, predation, and physiological stress.	• See mitigation above for "Water Retention in the Reservoir – Change in Fish Movement".	The residual effects of fish mortality as a result of water retention in the reservoir is adverse in direction, moderate in magnitude, restricted to the LAA, short-term in duration, and irregular in frequency. A fish habitat offsetting plan is being developed with consideration given to the potential loss of fish during flood operations.	A	M	LAA	ST	IR	R	U	S/R	The residual effects on fish mortality as a result of water retention in the reservoir are unlikely to pose a long-term threat to the persistence or viability of a fish species, including Species at Risk, in the RAA. With the application of mitigation measures, including a habitat offsetting plan, residual effects on fish mortality are predicted to be not significant.
		Change in water quality	Water retention in the reservoir will expose fish to relatively high concentrations of sediment for an extended duration of time relative to a natural flood event. Temperature may increase over time and DO may decrease over the duration of time that water remains within the reservoir. The changes to these water quality parameters can lead to physiological stress on fish.	• See mitigation above for "Water Retention in the Reservoir – Change in Fish Movement".	Water retention in the reservoir may cause an adverse effect on fish that become entrained in the reservoir during flood operation due to deteriorating water quality. It is expected that the magnitude of residual effects to fish that are entrained in the reservoir is moderate. The reservoir will be managed in a manner to optimize drawdown and reduce the amount of time water will be impounded. This will reduce the risk of water quality changes. Mitigation measures will be in place to rescue fish to the extent possible. Residual effects are expected to be short-term and irregular in frequency, because the effects are only anticipated during flood operations.	A	M	LAA	ST	IR	R	U	S/R	The residual effects on water quality as a result of water retention in the reservoir are unlikely to pose a long-term threat to the persistence or viability of a fish species, including Species at Risk, in the RAA. With the application of mitigation measures, including a habitat offsetting plan, residual effects on water quality are predicted to be not significant.

Table 78-1 Itemized Summary of Environmental Effects Assessment as it Relates to Fish and Fish Habitat

	Physical Activities	Potential Effect	Description of effect	Mitigation	Residual Effect	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological or Socio-economic Context	Timing	Significance of Residual Effect
Flood Operation and Post-Flood Operation (continued)	Reservoir water drawdown and release	Change in fish habitat	Reservoir water drawdown and release may subsequently lead to an increase in suspended sediment in Elbow River. This increase in sediment has the potential to alter habitat quality, particularly with the deposit of fine sediments in Elbow River. This sediment release can change the quality of habitat available to fish.	• A habitat offsetting plan is currently being prepared to mitigate potential changes to fish habitat. Furthermore, a post-construction habitat monitoring plan will be implemented to monitor habitat in Elbow River as a result of flood operation. This habitat monitoring plan will evaluate habitat quality in relation to pre-construction conditions to determine whether the offsetting measures align with the changes that are observed in habitat following flood operation.	The residual effect on fish habitat as a result of reservoir water drawdown and release is adverse in direction, moderate in magnitude, restricted to the LAA, short-term in duration, and irregular in frequency. Adult fish will likely seek refuge during reservoir drawdown and release. Some loss of habitat may occur due to the influx of sediments and higher flows, and this change in habitat will likely cause fish to seek temporary refuge. Substrate changes as a result of the introduction of sediments is expected to be temporary in nature; the persistence of channel forming flows (160 m^3/s) even during flood mitigation operations in Elbow River will maintain fish habitat quality for salmonid species.	A	M	LAA	ST	IR	R	U	S/R	The residual effects on fish habitat as a result of reservoir water drawdown and release are unlikely to pose a long-term threat to the persistence or viability of a fish species, including Species at Risk, in the RAA. With the application of mitigation measures, including a habitat offsetting plan, residual effects on fish habitat are predicted to be not significant.
		Change in flow	Reservoir water release could alter fish movement patterns (or timing of movement patterns) due to a change in flow.	• Habitat offsetting is currently being prepared to mitigate potential loss that may result from a change in flow and subsequent change to fish movement patterns for fish that migrate during the summer.	The residual effects of change in flow as a result of reservoir water drawdown and release is adverse in direction, low in magnitude, restricted to the LAA, short-term in duration, and irregular in frequency. Flood operation of the Project has the potential to delay or disrupt movement patterns for fish during reservoir drawdown and release. It is expected that a change in movement will be limited to a group of fish, such as adult bull trout, that migrate from downstream sections of Elbow River to upstream areas. Migration timing for this group of fish may disrupted or delayed as a result of flood operation.	A	L	LAA	ST	IR	R	U	S/R	The residual effects on flow as a result of reservoir water drawdown and release are unlikely to pose a long-term threat to the persistence or viability of a fish species, including Species at Risk, in the RAA. With the application of mitigation measures, including a habitat offsetting plan, residual effects on flow are predicted to be not significant.

Table 78-1 Itemized Summary of Environmental Effects Assessment as it Relates to Fish and Fish Habitat

	Physical Activities	Potential Effect	Description of effect	Mitigation	Residual Effect	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological or Socio-economic Context	Timing	Significance of Residual Effect
Flood Operation and Post-Flood Operation (continued)	Reservoir water drawdown and release (cont'd)	Change in water quality (in the Elbow River)	Changes in the quality of water released into Elbow River has the potential to temporarily expose fish to changes in some constituents (e.g., TSS, temperature, DO) and affect fish health.	• Mitigation to ameliorate water quality will not be implemented. A surface water monitoring plan will be in place and water quality samples will be collected to assess indicator parameters. The analytical results of these samples will be provided to stakeholders (e.g., the City of Calgary water treatment facility at Glenmore Reservoir) to manage water use. The reservoir drawdown will be managed to the extent possible to increase the rate of release and reduce the duration that water is in the reservoir.	Fish are predicted to find refuge (e.g., in groundwater fed evulsions and side channels) and or move out of the release plume to the extent possible (e.g., move upstream or downstream into the Glenmore Reservoir). Smaller fish, such as cyprinid species, may not be able to move adequately to find refuge and experience greater stress than large-bodied fish. The effects on fish health due to exposure to elevated TSS and temperature, and low DO are predicted to be acute to those fish that cannot find refuge; however, population level effects are expected to be temporary with low magnitude, occurring infrequently (with a frequency of less than 1:7 years) and reversible. The effects associated with other water quality constituents are expected to be minor and not measurable. These effects are not predicted to have a population level effect on resident fish species.	A	L	LAA	ST	IR	R	U	S/R	Effects of water released from the off-stream reservoir and associated plume to resident fish will be greater on the small bodied fish species than large-bodied fish that can find refuge from elevated TSS and temperature and low DO conditions. The offsetting plan will take into account the effects to resident fish and provide measures to maintain a sustainable fish community in Elbow River. Therefore, the effects on resident fish populations from a water quality plume is considered not significant.
		Fish entrainment	As water levels recede during drawdown, fish may become entrained in isolated pools that are located in the reservoir.	• The low-level outlet will be operated in a manner that allows fish egress from the reservoir and downstream into the unnamed creek during release of water from the reservoir. This mitigation measure addresses potential entrainment, or mortality of fish as a result of entrainment or predation. • Drainage areas within the reservoir will be graded to reduce stranding of fish during release of retained flood water from the reservoir.	The residual effect of fish entrainment as a result of reservoir water drawdown and release is adverse in direction, moderate in magnitude, restricted to the LAA, short-term in duration, and irregular in frequency. Design mitigation has been included to mitigate the potential effects to fish that are entrained, and a fish rescue and fish monitoring plan will be implemented during operation to mitigate the risk that fish become entrained as they move through the diversion channel, into the reservoir, and as they return into Elbow River upon reservoir drawdown.	A	M	LAA	ST	IR	R	U	S/R	The residual effects of entrainment as a result of reservoir water drawdown and release are unlikely to pose a long-term threat to the persistence or viability of a fish species, including Species at Risk, in the RAA. With the application of mitigation measures, including a habitat offsetting plan, residual effects of entrainment are predicted to be not significant.

Table 78-1 Itemized Summary of Environmental Effects Assessment as it Relates to Fish and Fish Habitat

	Physical Activities	Potential Effect	Description of effect	Mitigation	Residual Effect	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological or Socio-economic Context	Timing	Significance of Residual Effect
Flood Operation and Post-Flood Operation (continued)	Reservoir water drawdown and release (cont'd)	Fish entrainment (cont'd)	As water levels recede during drawdown, fish may become entrained in isolated pools that are located in the reservoir. (cont'd)	• During reservoir drawdown, fish monitoring will be necessary to identify isolated shallow areas that develop in the reservoir that could strand fish as the water levels drop. This monitoring will be done to inform fish rescue activities and will be directed by a qualified aquatic environmental specialist, professional fisheries biologist, or professional aquatic biologist. • Fish rescues will be conducted when safe and effective to do so. This mitigation measure is in place to address potential entrainment, impingement, or mortality of fish.										
		Fish mortality	As water levels recede during drawdown, fish may become stranded or trapped in sediment deposits in the reservoir such that mortality occurs. Fish may also be more vulnerable to predation during water drawdown. Mortality may also occur as a result of injury during travel through the low-level outlet, or through a sudden change in physical setting once re-introduced into Elbow River.	• Mitigation to address potential fish mortality is consistent with the measures that are proposed to mitigate "Reservoir water drawdown and release – Fish Entrainment" above.	The residual effect on fish mortality as a result of reservoir water drawdown is adverse in direction, moderate in magnitude, restricted to the LAA, short-term in duration, and irregular in frequency. Design mitigation has been included to mitigate the potential effects that lead to fish mortality, and a fish rescue and fish monitoring plan included in response to NRCB Question 31 (Appendix 31-1) will be implemented during operation to mitigate the risk of potential effects that lead to fish mortality during reservoir water drawdown and release.	A	M	LAA	ST	IR	R	U	S/R	The residual effects on fish mortality as a result of reservoir water drawdown and release are unlikely to pose a long-term threat to the persistence or viability of a fish species, including Species at Risk, in the RAA. With the application of mitigation measures, including a habitat offsetting plan, residual effects on fish mortality are predicted to be not significant.

Table 78-1 Itemized Summary of Environmental Effects Assessment as it Relates to Fish and Fish Habitat

***KEY**		
See individual chapters for detailed definitions	**Geographic Extent:**	**Frequency:**
Direction:	PDA: Project development area	S: Single event
P: Positive	LAA: local assessment area	IR: Irregular event
A: Adverse	RAA: regional assessment area	R: Regular event
N: Neutral		C: Continuous
	Duration:	
Magnitude:	ST: Short-term	**Reversibility:**
N: Negligible	LT: Long-term	R: Reversible
L: Low		I: Irreversible
M: Moderate	**Timing:**	
H: High	T: Time of Day	**Ecological/Socio-Economic Context:**
	S: Seasonality	U: Undisturbed
	R: Regulatory	D: Disturbed
	N/A: Not applicable	

References

Katapodis, C. 1992. Introduction to Fishway Design. Department of Fisheries and Oceans, Freshwater Institute Central and Arctic Region. Available at: https://www.engr.colostate.edu/~pierre/ce_old/classes/ce717/Manuals/Fishway%20design%20Katopodis/1992%20Katopodis%20Introduction%20to%20Fishway%20Design.pdf . Accessed March 2020.

Question 79

Supplemental Information Request 1, Question 357a, Page 5.279

Alberta Transportation responded that bull trout spawn in the area upstream of Bragg Creek (Applied Aquatic Research 2008).

This question has not been answered sufficiently. There is evidence that bull trout migrate past the proposed dam location and inhabit the section below the dam, including spawning downstream (R. Popowich and A. Paul, 2006).

a. Map existing critical or sensitive areas used by bull trout including migration and spawning routes.

Response

This response will be included in a future filing.

5 TERRESTRIAL

5.1 TERRAIN AND SOILS

Question 80

Supplemental Information Request 1, Question 374d, Page 6.33
Supplemental Information Request 1, Question 375c, Page 6.37
Supplemental Information Request 1, Question 376c, Page 6.39
Supplemental Information Request 1, Question 377c, Page 6.40
Supplemental Information Request 1, Question 378c, Page 6.43
Supplemental Information Request 1, Question 384d, Page 6.62
Supplemental Information Request 1, Question 385b, Page 6.63
Supplemental Information Request 1, Question 385d, Page 6.75

Alberta Transportation states in response to a number of different SIRs that *the soil analytical results of the screen soil...will be compared to the applicable guidelines*, but Alberta Transportation does not identify those guidelines.

a. Confirm that the soil data analyzed from all areas of potential environmental concern will be compared to "Alberta Tier 1 Soil and Groundwater Remediation Guidelines" (Alberta Environment and Parks, 2019, as amended) or "Alberta Tier 2 Soil and Groundwater Remediation Guidelines" (Alberta Environment and Parks, 2019, as amended).

Response

This response will be included in a future filing.

Question 81

Supplemental Information Request 1, Question 382a and Question 382c, Page 6.55

Alberta Transportation states that *removal of sediment from the reservoir to another off-site location is not planned*, but Alberta Transportation does not describe conditions where sediment removal or cleanup would be necessary.

a. Respond to the original SIR1 question 382c, by describing all potential conditions over the lifespan of the reservoir where sediment removal or partial removal would become necessary, regardless of whether it is planned or unplanned.

Response

This response will be included in a future filing.

Question 82

Supplemental Information Request 1, Question 383g, Page 6.56
Volume 1, Section 4.5, Table 4-1, Page 4.2

Alberta Transportation did not define "appropriate facility" as stated in Table 4-1.

a. **Respond to the original SIR1 question 383g to define appropriate facility.**

Response

a. An "appropriate facility" as stated in the EIA, Volume 1, Section 4.5, Table 4-1 is an *Environmental Protection and Enhancement Act* (EPEA) recognized facility approved for disposal of waste stream material (i.e., sediment from a flood).

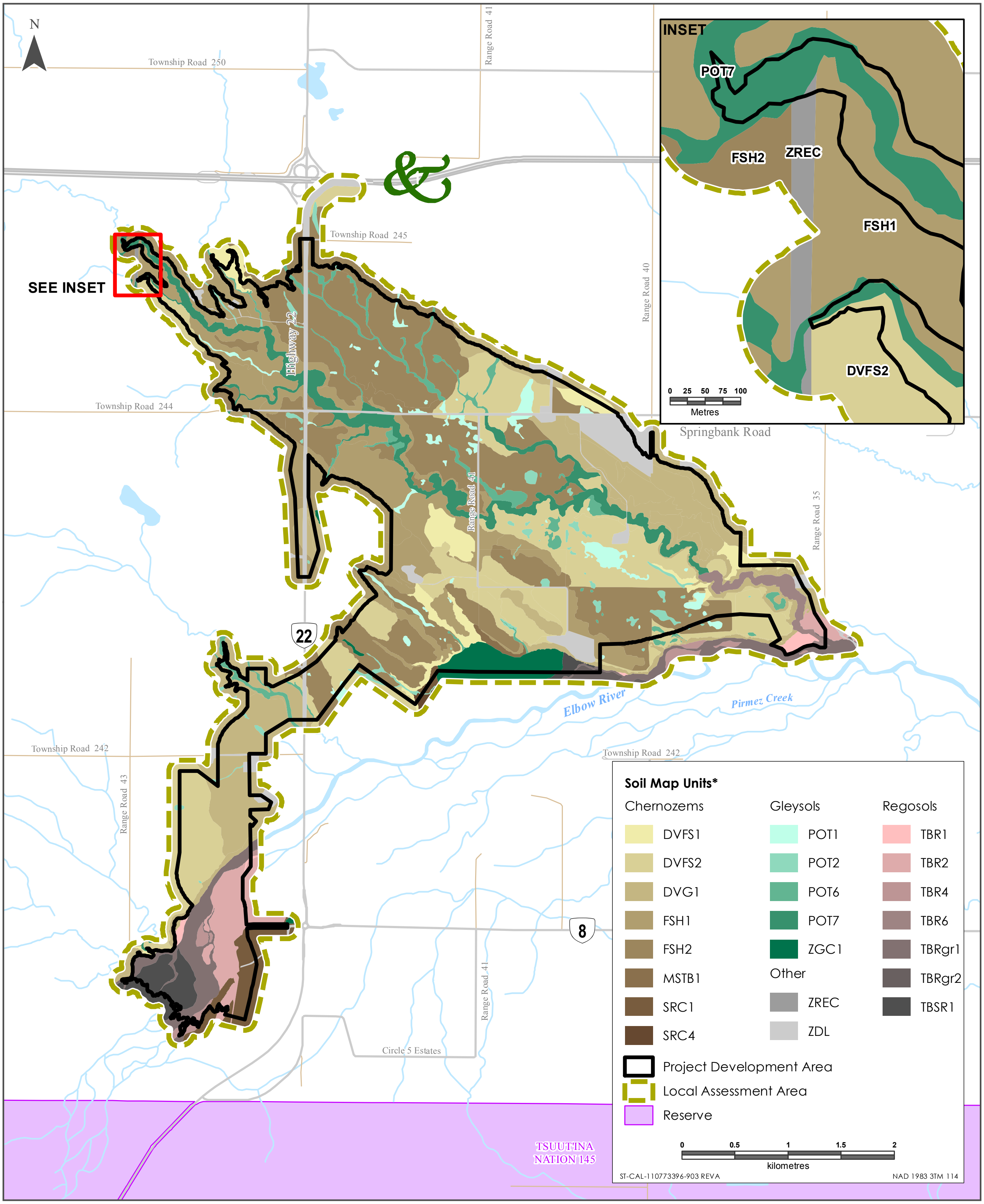
Question 83

Supplemental Information Request 1, Question 385a, Page 6.63
Volume 3A, Section 9.2.4, Page 9.25

a. **Respond to the original SIR1 question 385a and provide a map at a 1:5000 scale or finer resolution for the ZREC unit. The decision not to undertake higher resolution mapping due to the small size of the ZREC unit is not reasonable. Detailed mapping is required because Figure 9-5 (Volume 3A, page 9.25) does not clearly depict the location of the ZREC unit.**

Response

a. A map (Figure 83-1) is provided at a scale of 1:5,000 to show the location of the ZREC map unit delineation.



Sources: Base Data - Government of Alberta, Government of Canada, Thematic Data - Stantec Ltd.
Refer to Table 9-5 for Soil Map Unit descriptions.

Soil Map Units in the Project Development Area and Local Assessment Area with a focus on ZREC in the Northwest

Stantec

Question 84

Supplemental Information Request 1, Question 388b, Page 6.83

a. Respond to the original SIR1 question 388b to describe mitigation measures related to potentially contaminated sediment.

Response

a. The need for, and type of, mitigation measures related to potentially contaminated sediment will be determined through implementation of the post-flood soil monitoring plan (information on the proposed soil monitoring plan is provided in the response to AEP Question 85).

A component of the soil monitoring plan will include screening for evidence of potential soil contamination. In response to Round 1 AEP IR388a and based on the lack of any measurable soil contamination in the Elbow River floodplain at present, residual effects related to soil quality from contamination related to flood and post-flood phases are expected to be negligible. If monitoring finds contaminants of potential concern, appropriate mitigation will be identified and implemented. Depending on that risk assessment outcome, the spectrum of remediation options includes:

- encapsulation of the material
- removal of the material

If required, the soil will be disposed offsite at a facility approved under EPEA for receiving contaminated soil, dependent on the identified material, or may be isolated onsite depending on the risk-assessment outcomes.

Question 85

Supplemental Information Request 1, Question 394c, Page 6.95

a. Respond to the original SIR1 question 394c to address how post-flood sediments will be monitored for potential contaminants of concern, even if the intent is that they will be left in place.

Response

This response will be included in a future filing.

Question 86

Supplemental Information Request 1, Question 407, Page 6.118
Supplemental Information Request 1, Appendix IR407-1, Section 7.3, Page 7.4

Alberta Transportation states: *Topsoil, and where applicable, subsoil that has been salvaged and stockpiled during construction will be replaced on the site prior to decompaction*.

a. Was the intent to decompact the site before replacement of the topsoil and subsoil on the surface? Explain.

Response

a. Prior to topsoil and subsoil replacement, the site will be decompacted by deep ripping with at least two passes at 90 degrees to each other and to a depth of 20 cm to 25 cm or greater to breakup hardpan layers. After the site has been decompacted and contoured, subsoil and topsoil will be replaced. Depending on site conditions, the environmental inspector may suggest further decompaction for the subsoil and the topsoil horizons.

5.2 VEGETATION

Question 87

Supplemental Information Request 1, Question 401, Page 6.105
Supplemental Information Request 1, Appendix IR2-1, Page 2
Volume 1, Section 1.3.2.1, Figure 1-8, Pages 1.12, 1.13

In the Supplemental Information Request responses regarding future land use of the Springbank off-stream Reservoir Project, Alberta Transportation has revised their comments from the original Environmental Impact Assessment to now state *In general, only uses and activities that have a minimal impact on the land will be allowed. Therefore, the availability of surface dispositions will be limited*.

Certain agricultural dispositions, approvals, or authorizations, such as grazing leases, grazing licenses, grazing permits, head tax grazing permits, farm development leases, cultivation permits, and hay permits exist and are utilized by Alberta Environment and Parks to provide the opportunity for agricultural activity while at the same time making provisions for conditional and/or unrestricted access to the lands for exercise of First Nations treaty rights such as hunting.

a. **Given the presence of such dispositions, approvals, or authorizations, has Alberta Transportation considered these possible tools as an opportunity to continue to enable agricultural use of lands within Area C or Area B of the Project area during periods when there is no risk of interfering with the Primary Use of the project area for flood mitigation? Explain why or why not.**

b. **Has Alberta Transportation considered the possible benefits in the use of certain agricultural dispositions, approvals, or authorizations as a mitigation measure in managing both potential fire hazard from unutilized vegetative biomass and to avoid the potential creation of favourable microsites for noxious weed colonization commonly associated with the non-use of vegetative biomass production over extended periods? Explain why or why not.**

Response

a. The Draft Guiding Principles and Direction for Future Land Use (see Appendix 87-1) no longer refers to land use areas by the letter categories Area A to Area D in the PDA. Alberta Transportation is awaiting feedback from Indigenous groups, sent to Indigenous groups via emails on November 13 and 15, 2019.

   Alberta Transportation continues to actively engage Indigenous groups and stakeholders to identify options to utilize the Project area during periods when there is no risk of interfering with its primary use for flood mitigation. Potential land use options identified, including grazing permits for short-term grassland management, have been discussed as part of these engagement activities.

As engagement continues, this feedback will be used to refine and clarify the draft principles so as to determine how to appropriately manage the Project area for the identified secondary uses.

b. Alberta Transportation has considered the potential benefits of agricultural dispositions, approvals, or authorizations for managing vegetation, including weeds and biomass. These land use options could lower weed abundance, increase plant diversity (Blumenthal et al. 2012; Lancaster et al. 2015), lower weed control costs (Blumenthal et al. 2003) and reduce the risk of fire (Davies et al. 2010) or alter fire behaviour (Nader et al. 2007). Outcomes will vary depending on past land use (Renne and Tracy 2006), grazing intensity and animals used (Gibson 2009). However, and as identified in the response to a., Alberta Transportation is evaluating potential land use options and management approaches that reflect benefit to Indigenous groups and stakeholders. Engagement continues on these uses and Alberta Transportation will continue to work with AEP to determine appropriate management of the Project area. Some grazing through permit is being considered for the reservoir and, based on input from Indigenous groups, Alberta Transportation is evaluating opportunities for short-term use of culturally important grazing species such as bison and elk.

REFERENCES

Blumenthal, D.M., A.P. Norton, S.E. Cox, E.M. Hardy, G.E. Liston, L. Kennaway, D.T. Booth, and J.D. Derner. 2012. *Linaria dalmatica* invades south-facing slopes and less grazed areas in grazing-tolerant mixed-grass prairie. Biological Invasions. 14: 395-404.

Blumenthal, D.M., N.R. Jordan, and E.L. Svenson. 2003. Weed control as a rationale for restoration: the example of tallgrass prairie. Conservation Ecology. 7: 6 (online)

Davies, K.W., J.D. Bates, T.J. Svejcar, and C.S. Boyd. 2010. Effects of long-term livestock grazing on fuel characteristics in rangelands: An example from the sagebrush steppe. Rangeland Ecology and Management. 63: 662-669.

Gibson, D.J. 2009. Grasses and Grassland Ecology. Oxford University Press.

Lancaster, J., R. Adams, B. Adams, and P. Desserud. 2015. Long-term Revegetation Success of Industry Reclamation Techniques for Native Grassland: Foothills Fescue, Foothills Parkland and Montane Natural Subregions: Phase 1 – Literature Review and Case Studies – 2014. Prepared for: Land and Forest Policy Branch, Alberta Environment and Sustainable Resource Development.

Nader, G., Z. Henkin, E. Smith, R. Ingram, and N. Narvaez. 2007. Planned herbivory in the management of wildfire fuels: grazing is most effective at treating smaller diameter live fuels that greatly impact the rate of spread of a fire along with the flame height. Rangelands. 29: 18-24.

Renne, I.J. and B.F. Tracy. 2006. Disturbance persistence in managed grasslands: shifts in aboveground community structure and the weed seedbank. Plant Ecology. 190: 71-80.

Question 88

Supplemental Information Request 1, Question 407, Page 6.118
Supplemental Information Request 1, Appendix IR407-1, Page 7.2

Regarding seed mix selection for native areas, Alberta Transportation states pinegrass (Calamagrostis rubescens) and hairy wild rye (Leymus innovates) may be used as substitutes for species listed in the original species mix.

a. Given these two species are most commonly found in forested areas or on forest margins will they only be used in similar habitats for reclamation efforts or is the intent to utilize these species on areas where the site potential is open native grassland as well? Explain.

Response

a. Pinegrass (*Calamagrostis rubescens*) and hairy wild rye (*Leymus innovatus*) will be targeted for use in reclaimed forested areas impacted by the Project, not open native grassland. As indicated in the draft Vegetation and Wetland Mitigation, Monitoring and Revegetation Plan provided in Alberta Transportation's response to Round 1 AEP IR407, Appendix IR407-1, Alberta Transportation's custom seed mix will be adjusted in consideration of site-specific conditions of vegetation communities, input from Indigenous groups as to species that are culturally important to them, and representative community types for the Foothills Parkland Natural Subregion (DeMaere et al. 2012). Grass species typical of open native grassland in the Foothills Parkland Natural Subregion (e.g., foothills rough fescue [*Festuca campestris*] and slender wheatgrass [*Elymus trachucaulum*]) will be used to reclaim Project-disturbed native grassland communities.

REFERENCES

DeMaere, C., M. Alexander and M. Willoughby. 2012. Range Plant Communities and Range Health Assessment Guidelines for the Foothills Parkland Subregion of Alberta. First Approximation. Publication No. T/274.

Question 89

Supplemental Information Request 1, Question 407, Page 6.118
Supplemental Information Request 1, Appendix IR407-1, Page 7.1

For revegetation efforts Alberta Transportation states a target of noxious weed abundance as being *equivalent or lower than surrounding undisturbed areas and do not account for more than 25% of the total vegetation cover*.

The *Weed Control Act* states that a person shall control a noxious weed that is on land the person owns or occupies and that a person shall destroy a prohibited noxious weed that is on land the person owns or occupies.

a. Given a noxious weed cover of 25% is significant and may incur the potential of receiving a weed notice from the weed inspector is such a threshold target suitable? Explain.

Response

a. Alberta Transportation will control weeds following the *Alberta Weed Control Act* Regulations and Rocky View County requirements. Following the *Alberta Weed Control Act*, all prohibited noxious weeds in the PDA will be destroyed and noxious weed growth and spread will be inhibited. A target abundance of noxious weeds is not identified in the *Alberta Weed Control Act* or by Rocky View County. Alberta Transportation will work with Rocky View County on identifying suitable weed control measures and acceptable noxious weed levels. Weeds were frequently observed in the PDA and cover ranged from 0% to 25% (see Alberta Transportation's response to Round 1 AEP IR406) and full removal may not be possible for all noxious weed occurrences.

5.3 WILDLIFE

Question 90

Supplemental Information Request 1, Question 408, Page 6.1119
Supplemental Information Request 1, Figure IR408-1, Page 6.121

The Elbow River valley serves as a key wildlife and biodiversity zone (KWBZ) which is an important movement habitat for numerous wildlife species. It was identified during a meeting between AEP and Alberta Transportation, as part of the SIR review in 2019 that numerous wildlife collisions have been observed at the bridge.

a. **Explain why this area was not included in the EIA as a possible or potential wildlife collision prone location (Figure IR408-1).**

Response

a. Alberta Transportation is aware of one meeting between Alberta Transportation and AEP, which was on September 27, 2018, where three data sources were discussed related to animal-vehicle collisions: ENFOR, the Alberta Collision Information System (ACIS) and Alberta Wildlife Watch (AWW). The rationale for using or not using each of these three sources of information is provided in Alberta Transportation's response to Round 1 AEP IR408, wherein it is stated that the animal-vehicle collision prone locations (AVCPL) for large-bodied animals provided in Figure IR408-1 are based on a two step analysis of the AWW data using the Kernel Density Estimate (KDE+) software, and animal carcass density (see Appendix B in GoA 2017). At the time of analysis, the area indicated by AEP was not identified as a possible or potential AVCPL because the number of animal-vehicle collisions did not meet the threshold (as defined in the analysis) to be identified as an AVCPL. The AWW Program will continue to monitor this area for determining in the future whether it meets the threshold of a collision-prone location.

REFERENCES

GoA (Government of Alberta). 2017. Alberta Wildlife Watch Program. Available at: https://open.alberta.ca/dataset/7c852b82-ecd3-4701-8d84-0b5addbe54ce/resource/d986571a-22bb-41ab-9630-cd4fa9c8cb7b/download/albertawildlifewatchprogramplan.pdf

Question 91

Supplemental Information Request 1, Question 409, Page 6.122

Montane elk study research publications were available at the time this EIA was written. These research publications could have been used to describe estimates of habitat use and avoidance as a result of human and vehicular access. These publications were not used in the EIA references (Authors Paton, Ciuti, Boyce, Muhly) for elk and grizzly bear (http://www.biology.ualberta.ca/www.montaneelk.com/updates.php).

a. Explain why the research publications of montane elk were not used in the EIA to inform expected impacts due to human and vehicular use.

Response

a. Research from the montane elk study, as well as other relevant literature, were used in the wildlife assessment: Paton 2012; Ciuti et al. 2012; Pruvot et al. 2014; Prokopenko 2016; Seidel and Boyce 2016 (see EIA, Volume 4, Appendix H, Attachment 11A, Section 11A.3). Specifically, the literature related to the montane elk study and other relevant regional information was used for development of the elk habitat suitability models (see Volume 4, Appendix H, Attachment 11A, Section 11A.2.4). The elk species account included references from the montane elk study as well as other research related to elk ecology and habitat requirements. The elk species account also includes habitat suitability rating adjustments related to human disturbances, including vehicle traffic (i.e., sensory disturbance).

The potential direct and indirect effects of the Project on elk habitat are based on results of the elk winter and summer feeding habitat suitability maps, which were generated using the relevant montane elk research publications.

REFERENCES

Ciuti, S., J.M. Northrup, T.B. Muhly, S. Simi, M. Musiani, and J. A. Pitt. 2012. Effects of humans on behaviour of wildlife exceed those of natural predators in a landscape of fear. PLoS ONE 7(11): e50611.

Paton, D. 2012. Connectivity of Elk Migration in Southwestern Alberta. Master's Thesis – University of Calgary, Calgary Alberta

Prokopenko, C.M. 2016. Multiscale Habitat Selection and Road Avoidance of Elk on their Winter Range. M.Sc. Thesis. University of Alberta, Edmonton, AB.

Pruvot, M., D. Seidel, M.S. Boyce, M. Musiani, A. Massolo, S. Kutz, and K. Orsel. 2014. What attracts elk onto cattle pasture? Implications for inter-species disease transmission. P*reventative Medicine* 117: 326-339.

Seidel, D.P. and M.S. Boyce. 2016. Varied tastes: home range implications of foraging-patch selection. *Oikos* 125: 39–49.

Question 92

Supplemental Information Request 1, Question 409, Page 6.122
Supplemental Information Request 1, Question 410, Page 6.123
Supplemental Information Request 1, Figure IR411-2, Page 6.128

a. **Explain and clarify if the Wildlife Crossing Structures Handbook specifications will be adhered to for the crossing structure/culvert on highway 22 (Figure IR411-2 pg 6.128). If not, explain why these specifications will not be adhered to and the adequacy of the proposed design. https://roadecology.ucdavis.edu/files/content/projects/DOT-FHWA_Wildlife_Crossing_Structures_Handbook.pdf.**

b. **The current fencing in place for this culvert is designed for cattle and prevents most ungulate wildlife crossings. Will this fencing be modified to enable wildlife movement? If not, then explain why no modifications will be made.**

Response

a. The Wildlife Crossing Structures Handbook (Clevenger and Huijser 2011) is a compilation of projects completed by other jurisdictions, including the Netherlands, Spain and a few U.S. states (Arizona, Florida, Washington). It is not a regulatory document and has not been formally adopted by Alberta. However, Alberta Transportation has reviewed the handbook for guidance and the following dimensions and design principles for the as-designed underpass and culvert are consistent with its guidance:

- Height (10 m) and width (24 m) of the Highway 22 bridge over the diversion channel (underpass) exceeds the recommended height (greater than 4 m) and width (greater than 10 m) for large mammal underpasses.
- Cover along one or both culvert walls using salvage materials (logs, root wads, rocks, etc.) will be considered to encourage culvert use by small and medium-sized mammals. The width (3.67 m) and height (2.45 m) of the culvert that will be replaced at the bottom of the raised intersection on Highway 22, as shown in Alberta Transportations response to Round 1 AEP IR411, Figure IR411-2, aligns with the recommended dimensions for small and medium-sized mammals (e.g., coyote, fox) provided in the Wildlife Crossing Structures Handbook.

b. The current fencing in place for this culvert will be removed and replaced with wildlife-friendly fencing.

REFERENCES

Clevenger, A.P., and Huijser, M.P. 2011. Wildlife Crossing Structure Handbook Design and Evaluation in North America. 223 pp. Available at: https://roadecology.ucdavis.edu/files/content/projects/DOT-FHWA_Wildlife_Crossing_Structures_Handbook.pdf

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Question 93

Supplemental Information Request 1, Question 412, Page 6.129

This question has not been answered sufficiently.

a. **Explain in additional detail how and/or if wildlife crossing deterrent fencing will be used to guide animals to preferred crossing areas. Provide a map explaining where the project expects ungulate movement to be negatively impacted.**

b. **Explain how an increase in expected or unexpected vehicle wildlife collisions will be mitigated in the future.**

c. **Will adjoining land fencing also facilitate this intended movement? Explain why or why not.**

Response

a. Wildlife-exclusion fencing (to guide animals to preferred crossing areas such as the Highway 22 bridge over the diversion channel) is not proposed as part of the Project. All fencing installed will be wildlife-friendly so as to facilitate free wildlife movement within the PDA. The effectiveness of the mitigation to facilitate wildlife movement in the PDA and wildlife LAA will be evaluated as part of the final WMMP.

   Project structures have potential to create physical and sensory barriers to ungulate movement (e.g., elk, deer) (see EIA, Volume 3A, Section 11.4.3.3). Wildlife movement is expected to be affected where permanent Project structures (such as the diversion channel, floodplain berm, and off-stream dam) will be built.

   Results from wildlife baseline surveys (e.g., winter tracking, remote camera) indicated the following locations where ungulates (deer, elk, moose) or their tracks were observed (see Figure 93-1):

   - On Highway 22 approximately 1 km north of the Highway 22 bridge near Pirmez Creek. Elk tracks were observed crossing Highway 22 and continued heading southwest across Township Road 242. This travel route intersects the southern portion of the diversion channel footprint where elk movement will be altered during construction.

- East of Highway 22 between Springbank Road and the TransCanada Highway where elk were detected moving north and south along a wildlife trail. This area is adjacent to the section of Highway 22 that will be permanently raised during Project construction. Construction activities have potential to temporarily alter elk movement in this area.
- West of Highway 22 where deer and elk tracks were observed travelling east-west across Range Road 43 as well as north-south across Township Road 242 and 244. Construction of the diversion channel and construction activities associated with raising Highway 22 has potential to affect deer and elk movement near these areas.
- Along Elbow River and crossing Elbow River. Deer and elk movement along Elbow River will be altered during construction of the diversion structure and floodplain berm.
- Along the floodplain berm where deer tracks were observed (see Volume 4, Appendix H, Section 3.7.2, Table 3-11). Deer movement along Elbow River will be altered during construction of the diversion structure and floodplain berm.
- East of Highway 22 between the proposed diversion channel and Elbow River where moose tracks were observed travelling east-west. Construction activities have potential to affect moose movement during construction of the diversion structure.

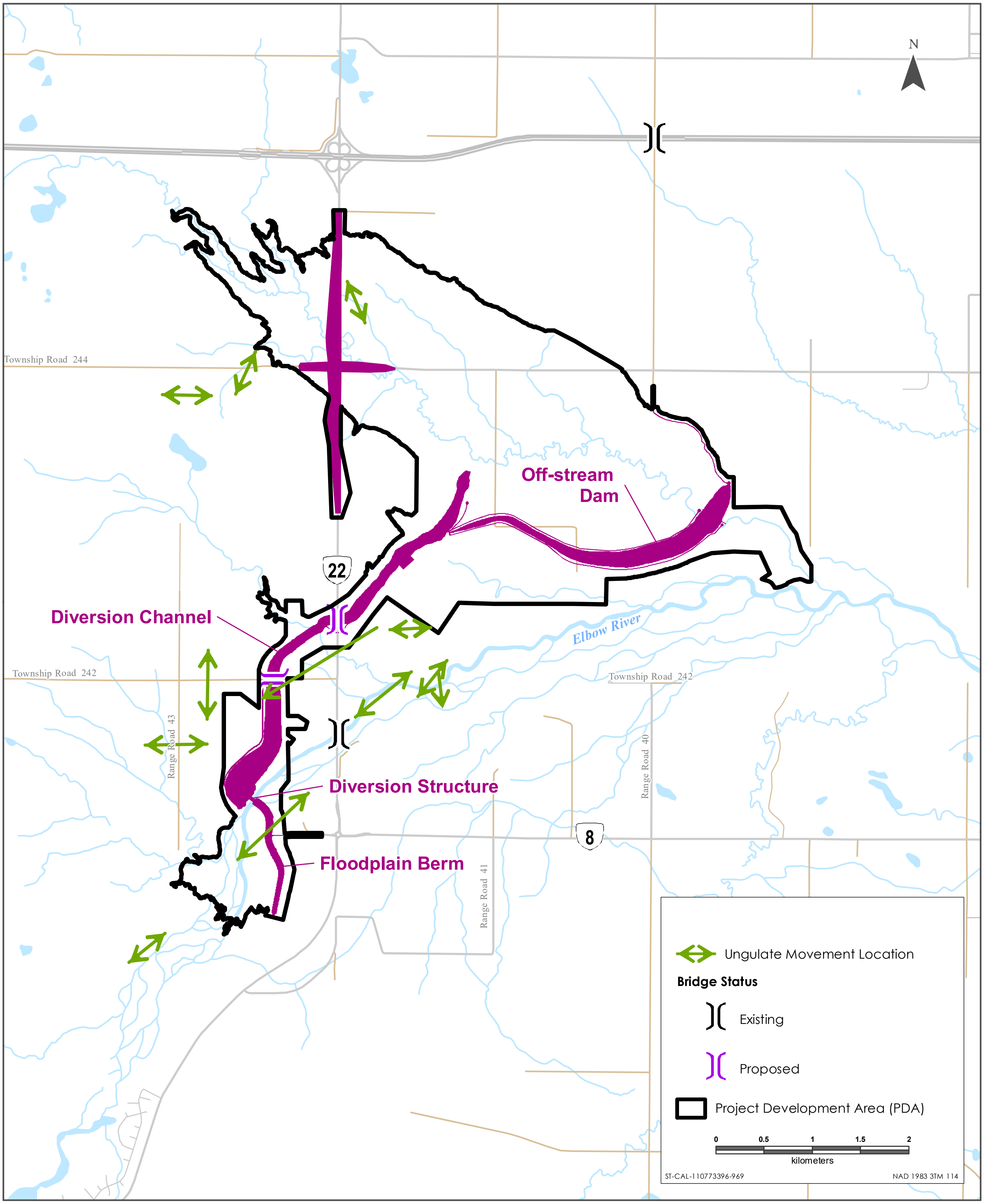
The elk movement locations described above (e.g., across Highway 22 and Elbow River) were also identified in the Tsuut'ina Traditional Land Use Report as elk migration routes (Tsuut'ina Nation 2018).

The remote monitoring program will help determine whether ungulates continue to use these travel routes and provide data to evaluate their response when encountering Project components such as the diversion channel and floodplain berm during dry operations.

b. During construction, increases in Project-related traffic volumes will be managed through the Traffic Accommodation Strategy (see Volume 3A, Section 16.4.2.2), which will reduce potential mortality risk related to animal-vehicle collisions in the LAA. During dry operations, traffic volumes are expected to return to baseline conditions. The Project will not result in increases in traffic volumes (see Alberta Transportation's response to Round 1 AEP IR410d). There is no expected increase in wildlife collisions; however, unexpected increases would be addressed through adaptive management.

   In addition, there will be monitoring of animal-vehicle collisions as part of the AWW Program. The AWW Program is designed to identify animal-vehicle collision prone locations and to monitor and evaluate the effectiveness of mitigation (AEP 2017).

c. All fencing is described in Round 1 AEP IR413. Fencing has not been designed to guide wildlife movements. Fence types have been selected to not impede wildlife movement through the PDA.



Sources: Base Data - Government of Alberta, Government of Canada, Thematic Data - Stantec Ltd.

Ungulate Movement Locations Observed During Wildlife Baseline Surveys

Stantec

ALBERTA TRANSPORTATION SPRINGBANK OFF-STREAM RESERVOIR PROJECT ENVIRONMENTAL IMPACT ASSESSMENT

Figure 93-1

References

AEP (Alberta Environment and Parks). 2017. Alberta Wildlife Watch Program. Available at: https://open.alberta.ca/dataset/7c852b82-ecd3-4701-8d84-0b5addbe54ce/resource/d986571a-22bb-41ab-9630-cd4fa9c8cb7b/download/albertawildlifewatchprogramplan.pdf

Tsuut'ina Nation. 2018. Tsuut'ina Traditional Land Use Report for the Proposed Springbank Off-Stream Reservoir Project. Prepared by Tsuut'ina Nation and Trailmark Systems. Prepared for Alberta Transportation.

Question 94

Supplemental Information Request 1, Question 413, Page 6.130

Many other types of wildlife friendly fence designs are available.

a. Explain if gates, jump rails or drop sections of fences have been considered.

b. Explain if gates, jump rails or drop sections of fences will be used to further enhance ungulate movement at all times and/or at times when livestock are not required to be contained (in the event livestock use is permitted) in both internal and external project fences.

c. If gates, jump rails or drop sections of fences have not been considered, explain why not.

Response

a. and c. Other options are available, including gates, jump rails and drop sections that can facilitate or enhance wildlife passage where traditional barbed-wire fencing or wildlife-friendly fencing exists. However, gates, jump rails or drop sections of fences have not been considered because all barbed-wire fences will be removed in the PDA and replaced with wildlife-friendly fencing, which is expected to facilitate wildlife movement in the LAA. The final WMMP will describe opportunities to assess the effectiveness of the proposed wildlife-friendly fencing.

b. All internal (existing barbed wire) fencing to the reservoir will be removed. All fencing around the perimeter of the PDA, in the raised section of Highway 22, and along Springbank Road within the reservoir will be wildlife-friendly, which is designed to facilitate wildlife movement in the PDA and LAA. Wildlife-friendly fencing will contain livestock (as required) consistent with the direction identified in the Draft Guiding Principles and Direction for Future Land Use (see the response to AEP Question 87, Appendix 87-1), which states that grazing permits may be issued within designated zones, and at certain times, where determined by AEP, as the appropriate tool to manage grasslands for ecosystem health or wildfire mitigation.

c. Gates, jump rails and drop sections have not been included in the design of the wildlife-friendly fencing because the removal of internal barbed-wire fencing (within the PDA) and installation of wildlife-friendly fencing around the perimeter of the PDA will enhance wildlife permeability. However, monitoring the effectiveness of the wildlife-friendly fencing will be described in the final WMMP.

Question 95

Supplemental Information Request 1, Question 414, Page 6.132
Supplemental Information Request 1, Question 410c, Page 6.124

The response states the qualitative approach taken is sufficient and standard. However, this approach has created uncertainty on project effects to wildlife movement.

a. Explain how an enhanced assessment and monitoring design could have been utilized to better understand the impacts of the project. Explain why this approach was not taken.

Response

a. The potential effects of the Project on wildlife movement were assessed using a qualitative approach, which was enhanced with quantitative information from winter tracking surveys and remote camera data collected as part of the baseline surveys as well as available information from traditional use studies. To further enhance the assessment on wildlife movement would require additional quantitative data on animal movement within the LAA (e.g., daily and seasonal travel routes, daily distance travelled, movement rate), which is typically collected by government or academic institutions using telemetry (i.e., GPS collared animals).

   Although the EIA included a brief discussion of grizzly bear movement based on a small sample of telemetry information provided by AEP, it does not provide a detailed assessment of grizzly bear movement in the LAA (see Alberta Transportation's response to NRCB Question 35). AEP provided an elk study conducted in 1982 (Eslinger et al. 1982); however, it has limited utility to inform the wildlife assessment based on the date of the study, the limited number of radio-collared elk (total of seven collared elk, of which only two elk were from the nearby Jumpingpound herd), the type of radio collar (VHF) and the spatial distribution of the elk herds sampled, which did not overlap the LAA.

   The qualitative approach used to assess wildlife movement is consistent with provincial and federal EIAs previously completed for approved major projects where there is an absence of quantitative movement data within local assessment areas (Glacier 2006; CNRL 2012; Athabasca Oil 2013; Suncor 2017).

Alberta Transportation has developed a draft WMMP (see Alberta Transportation's response to Round 1 AEP IR425, Appendix IR425-1). As described in the draft WMMP, potential Project effects on wildlife will be monitored. Monitoring would occur during construction, post-Project approval, and dry operations, primarily to determine the effectiveness of proposed mitigation measures and to confirm the conclusions of the assessment. At that time, monitoring results will be used to evaluate the effects of the Project and, if necessary, refine mitigation. Monitoring is not a component of baseline data collection. The AWW Program will also continue to monitor wildlife sightings along Highway 22 into the future.

Some scientific uncertainty exists regarding wildlife movement because there is limited information available related to animal responses to Project components, such as the diversion channel. The final WMMP is being designed to evaluate how wildlife movement is potentially affected due to permanent Project structures and the relative effectiveness of proposed mitigation measures, which can be used to validate the assessment predictions.

REFERENCES

Athabasca Oil (Athabasca Oil Corporation). 2013. Application for Approval of the Hangingstone Expansion Project. Available at: https://dds.aer.ca/iar_query/ApplicationAttachments.aspx?AppNumber=1762708

CNRL (Canadian Natural Resources Ltd). 2012. Grouse In-Situ Oil Sands Project. Available at: https://dds.aer.ca/iar_query/ApplicationAttachments.aspx?AppNumber=1720859

Eslinger, D. H., K.P. Schmidt, and J.R. Gunson. 1982. Evaluation of microwave detector-scarers in prevention of elk damage to stacked feed. Alberta Energy and Natural Resources. Fish and Wildlife Division.

Glacier (Glacier Power Ltd.). 2006. Dunvegan Hydroelectric Project. Available at: https://iaac-aeic.gc.ca/052/details-eng.cfm?pid=2996

Suncor (Suncor Energy Inc.). 2017. Meadow Creek West Project. Available at: https://dds.aer.ca/iar_query/ApplicationAttachments.aspx?AppNumber=1899100

Question 96

Supplemental Information Request 1, Question 415, Page 6.134
Volume 3A, Section 11.2.2.4, Page 11.28

Alberta Transportation states *the frequency of grizzly bear use is expected to be low based on the information presented in Volume 3A, Section 11.2.2.4, page 11.28, which indicates the wildlife LAA provides relatively low suitability habitat*.

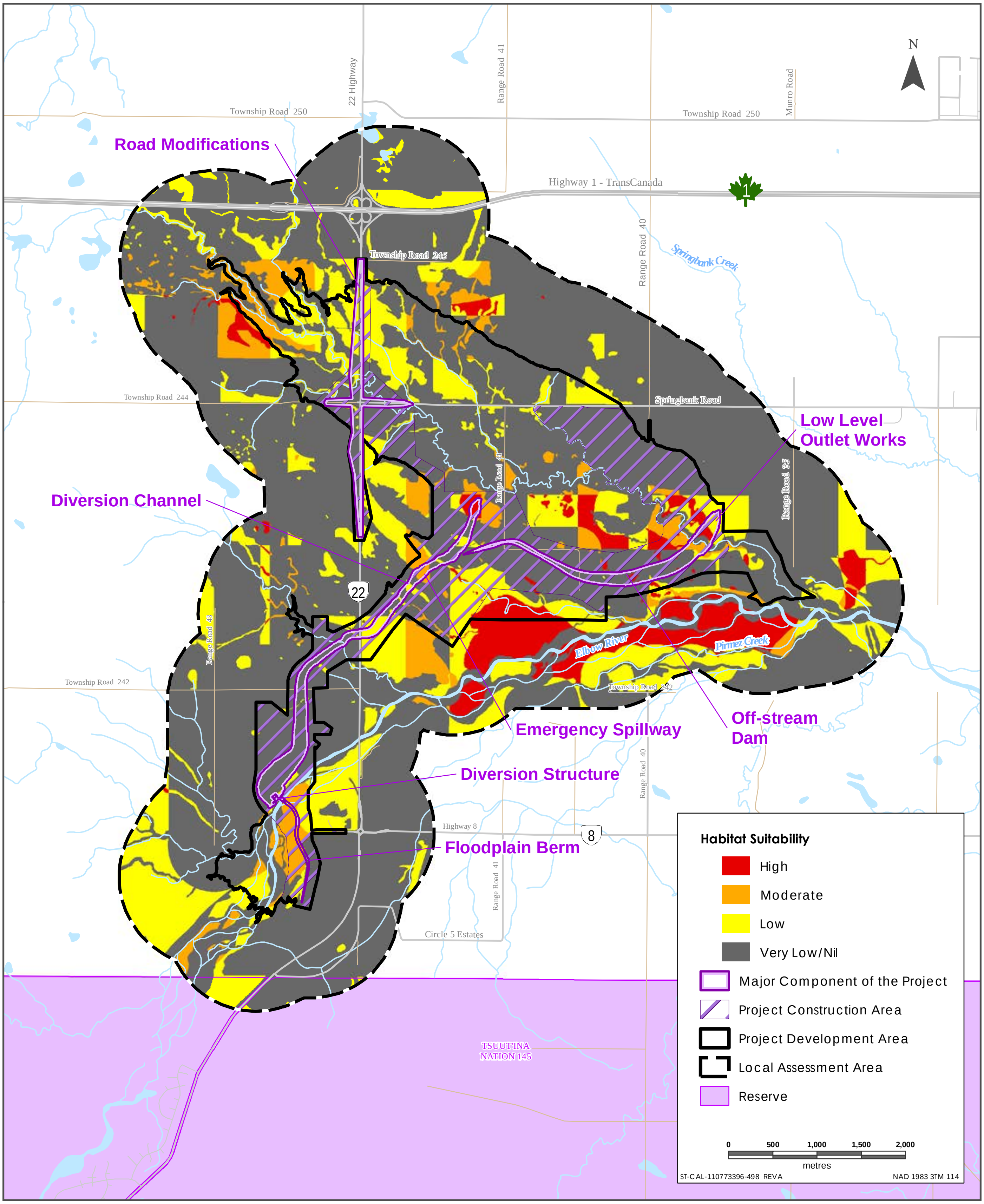
a. Explain how a major riparian watercourse movement corridor and KWBZ with native prairie uplands and abundant big game populations can be considered low suitability habitat for grizzly bear considering this habitat is known to support numerous adult and young grizzly bears and is adjacent to the draft recovery plan's identified support zone.

Response

a. The quoted statement applies to the wildlife LAA, wherein the LAA (4,860 ha) is dominated by agricultural land including tame pasture (27.3%), cropland (11.3%), hayland (9.7%) and disturbed land (6.1%)(see the EIA, Volume 3A, Section 11, Table 11-6). These non-native cover types were rated low or very low suitability, as described in Volume 4, Appendix H, Section 11A 2.5. There is higher value grizzly bear habitat in the LAA, including areas identified along Elbow River that provide both high and moderate spring feeding habitat suitability (see Figure 96-1, which is reproduced from Volume 3A, Section 11, Section 11.2.2.4, Figure 11-8).

   As described in Volume 4, Appendix H, Section 11A 2.5, ecosites that contain preferred spring forage plants (e.g., grass, sedge, horsetail) are grassland and mature open forests along riparian areas and are rated as high suitability habitat prior to any applicable ratings adjustments for anthropogenic disturbance, which is assumed to reduce suitability. In addition, riparian areas and shrublands that might provide winter-killed ungulates or calves are also rated high prior to any applicable ratings adjustments for anthropogenic disturbance.

   Only a small amount of the PDA (2.8%) overlaps the key wildlife and biodiversity zone (KWBZ) identified along Elbow River (see Alberta Transportation's response to Canadian Environmental Assessment Agency [CEAA] Annex 2, Question 27b). As discussed in Volume 3A, Section 11.2.2.1, the western boundaries of the wildlife LAA and wildlife RAA overlap the grizzly bear Support Zone identified in the draft Alberta Grizzly Bear Recovery Plan (AEP 2016), which identifies priority management actions to reduce attractants and bear-human conflict.



Sources: Base Data - Government of Alberta, Government of Canada, Thematic Data - Stantec Ltd.

Grizzly Bear Spring Feeding Habitat Suitability in the LAA – Existing Conditions

Stantec

ALBERTA TRANSPORTATION SPRINGBANK OFF-STREAM RESERVOIR PROJECT ENVIRONMENTAL IMPACT ASSESSMENT

Figure 96-1

REFERENCES

AEP (Alberta Environment and Parks). 2016. Alberta Grizzly Bear (*Ursus arctos*) Recovery Plan (Draft). Alberta Environment and Parks, Alberta Species at Risk Recovery Plan No. 38. Edmonton Ab. 85 pp.

Question 97

Supplemental Information Request 1, Question 417, Page 6.316

The response has not included any impact assessment of on-foot human access to the site.

a. Explicitly describe and explain how foot or water-based access and recreation facilities will affect wildlife use, conflicts, and mortality.

Response

a. For safety reasons, there will be no public access when the reservoir is retaining water. Therefore, there is no potential effect of human foot or water-based access on wildlife during flood operations. The proposed Draft Guiding Principles and Direction for Future Land Use (see the response to AEP Question 87, Appendix 87-1) will address land-based access and will be refined following engagement with Indigenous groups and stakeholders. The primary land use will be for flood mitigation and when not being used for flood mitigation, secondary uses include First Nations' traditional activities such as hunting and traditional and medicinal plant gathering and low impact activities such as hiking and cross-country skiing.

   There is potential for human-wildlife conflict and increased wildlife mortality risk (e.g., bears) during dry operations (between floods), which is discussed in the EIA, Volume 3A, Section 11.4.4; the reduction of on-site activity (i.e., after construction ceases) would reduce the likelihood of Project-related wildlife-human conflict. The extent of public access will be guided by the final principles for future land use; however, human-wildlife conflicts are not expected to increase relative to existing agricultural and residential land uses.

   The Project will not change water-based access along Elbow River during dry operations and there will be no recreation facilities built within the PDA. Therefore, these activities were not assessed.

Question 98

Supplemental Information Request 1, Question 418, Page 6.316

a. **The term nuisance animal is not in the Alberta Wildlife Regulation and is a term used by the *Agricultural Pests Act* and regulations. Correct the response so that the correct regulation is referenced.**

b. **Explain how this term has been used in this section and the terminology around nuisance animal.**

It is noted in the response to this question that the proponent has not obtained all information available, nor gathered additional information with which to enable prediction of human wildlife conflicts.

c. **Explain the ability to predict these conflicts with the limited information provided and explain if this deficiency will be addressed. If this deficiency will not be addressed, explain why.**

d. **Confirm that the GOA is the authority and will take appropriate action as per established conflict wildlife policies and protocols where responsible.**

e. **Confirm that Alberta Transportation understands that all occupied dens are protected under the *Wildlife Act* and Regulation.**

Response

a. The term "nuisance" was not meant to be explicitly interpreted as per the definition defined in the *Agricultural Pests Act* but rather was used more broadly as discussed in the EIA, Volume 3A, Section 11.4.4.1, which states an increase in wildlife-human conflict could result in attractants (e.g., garbage) in the PDA that might cause unwanted wildlife to enter the construction area while humans are present. Nuisance animals would include species that might enter the construction area and result in a wildlife-human conflict such as a coyote or a bear. The response is not referring to a specific clause in legislation and the conclusions of the assessment are not changed.

b. See response to a. and Alberta Transportation's response to Round 1 AEP IR418a. The potential increase in wildlife mortality risk is assessed qualitatively. The removal of an animal involved in a wildlife-human conflict may require lethal means but also refers to other methods that could be used to resolve or reduce the risk of mortality. As stated previously in response to NRCB Question 35, any human-bear conflict would be reported to AEP (Fish and Wildlife).

c. The potential increase in wildlife mortality risk is assessed qualitatively. The assessment does not attempt to predict the number of human-wildlife conflicts (e.g., bear) but rather assumes there is a potential for increased risk of mortality because there will be increased human presence in areas where wildlife (e.g., bears) might occur as discussed in Volume 3A, Section 11.4.4. The EIA was prepared using available information, as discussed in the response to NRCB Question 35a. As indicated in that response, Alberta Transportation has not identified a deficiency to be addressed.

d. Alberta Transportation will implement mitigation that is consistent with established policies and protocols related to human-wildlife conflict. As stated in Alberta Transportation's response to Round 1 AEP IR415 and NRCB Question 35, Alberta Transportation has proposed mitigation to reduce human-wildlife conflicts. If a bear-human interaction occurs, the incident would be reported to the environmental inspector and AEP (Fish and Wildlife).

e. Alberta Transportation accepts that all occupied dens are protected under the Alberta *Wildlife Act* and Regulation.

Question 99

Supplemental Information Request 1, Question 419, Page 6.139

Native elk habitat is of much greater value than modified habitat.

a. Explain why native habitat will be replaced by modified habitats instead of being restored.

b. Explain the loss in habitat value that will occur as a result and provide a detailed map where this loss is expected. Note: the current descriptions are deficient.

c. Explain why Alberta Transportation is proposing actions that will degrade habitat and not proposing to restore these losses.

Response

a. Modified communities described in Round 1 AEP IR419 are early seral forested and shrubby communities temporarily disturbed by construction, or flood events. These areas are expected to be dominated by native grass and forb species following construction and flood events, which will provide potential foraging areas for elk.

   Restoration of habitat is not proposed because of the complexity involved in restoring habitat to conditions present prior to disturbance which can include challenges, such as:

   - the lack of availability of seed for all pre-disturbance species
   - some species are later seral species and do not establish readily following disturbance

- the long time involved for complete restoration to occur
- the potential for disturbance and disruption of restoration efforts by future flooding

Reclamation of communities is more successful at establishing a trajectory toward a desired community type and reclamation would target species more resilient to future flooding.

The Project revegetation plan has been developed to adaptively manage revegetation efforts, with the goal of revegetating high-quality areas with appropriate native seed mixes. There is greater likelihood of success with reclamation compared to restoration, and reclaimed areas will be supported by natural recovery, which is expected to occur over time.

Reclamation of disturbed lands is standard practice for areas disturbed by development in Alberta (such as much of the existing PDA and wildlife LAA). Revegetation plans for the Project align with Alberta provincial guidance of returning land to an equivalent land capability (Province of Alberta 2019). Equivalent land capability means that after conservation and reclamation, the ability of land to support various land uses is similar to what existed prior to an activity being conducted on the land, but that individual land uses will not necessarily be identical.

Alberta Transportation has prepared a Draft Vegetation and Wetland Mitigation, Monitoring, and Revegetation Plan (see Alberta Transportation's response to Round 1 IR407, Appendix IR 407-1). This plan will be revised and updated prior to construction and will include input received through ongoing discussion with regulators, including AEP, and Indigenous groups. Alberta Transportation will work with AEP and Indigenous groups to determine the desired reclamation conditions and modify seed mixes as applicable. With proposed mitigation, native species, including trees and shrubs, should re-establish on disturbed sites. Tree and shrub species are expected to re-establish through natural processes by root suckering (e.g., aspen [*Populous tremuloides*]), rhizomes (e.g., snowberry [*Symphoricarpos occidentalis*], silverberry [*Elaeagnus commutata*]) and in time by seeds (e.g., white spruce [*Picea glauca*], red-osier dogwood [*Cornus stolonifera*]) (Esser 1994; Howard 1996a; Hauser 2007; Gucker 2012).

b. In the wildlife assessment, habitat value refers to the suitability of an area to support a specific life-requisites (e.g., food, cover) for a wildlife species. Habitat value was assessed for six key indicator species using habitat suitability models, which used a four-class rating scheme (high, moderate, low and very low/nil) to rate habitat suitability for each habitat type in the LAA (see EIA, Volume 3A, Section 11.2.1.3 and Volume 4, Appendix H, Section 11A.1.1).

Additional detail regarding the change in elk winter feeding habitat (ha) suitability during construction and dry operations referred to in Round 1 AEP IR419 is provided in Table 99-1. During construction, the Project will directly and indirectly affect 116.9 ha of high suitability elk winter feeding habitat in the wildlife LAA. Of that, there will be a loss of 3.9 ha associated with permanent project components (see Figure 99-1), and a temporary loss of 53.7 ha for temporary components (i.e., temporary workspaces), which will be reclaimed. The remaining high suitability elk winter feeding habitat affected (59.3 ha) is due to zone of influence (ZOI) buffers used to estimate indirect habitat loss due to sensory disturbance. ZOI buffers of 250 m to 500 m were applied to anthropogenic features as well as to Project components during construction and dry operations, which reflects a reduction in habitat suitability due to sensory disturbance.

The Project will directly affect 376.7 ha of moderate suitability elk winter feeding habitat in the LAA. Of that, there will be a loss of 20.6 ha associated with Project components, and a temporary loss of 106.3 ha within the construction area, which will be reclaimed. The remaining moderate suitability elk winter feeding habitat affected (249.8 ha) is due to ZOI buffers used to estimate indirect habitat loss due to sensory disturbance.

The habitat value or suitability of reclaimed areas is accounted for in the suitability ratings in the elk winter feeding habitat suitability model: the amount of elk winter habitat available during dry operations reflects the habitat value of the reclaimed areas (i.e., temporary workspaces being reclaimed to grassland species) as well as the estimated indirect loss due to sensory disturbance. The application of the ZOIs for sensory disturbance to the major Project components (such as the dam) during the dry operations phase of the project is a conservative overestimation of the reduction in habitat suitability.

The amount of high and moderate suitability elk winter feeding habitat affected during dry operations is primarily due to the estimated indirect loss due to sensory disturbance, which includes 67.4 ha and 218.2 ha of high and moderate suitability habitat, respectively (Table 99-1).

c) The Project will directly and indirectly affect native grassland and elk habitat, but proposed reclamation is not considered to degrade elk habitat. Native and agronomic seed mixes will contain forage grass species used by elk, and they will provide suitable feeding habitat. Trees and shrubs will be allowed to naturally establish following construction and native seed mixes will be applied where needed. Alberta Transportation will consider recommended plant species by AEP to be included during reclamation to supplement natural re-vegetation of the area. These suggested plant species will be considered with those suggested by Indigenous groups.

As described in the response to a., restoration of these areas to conditions identical to those prior to disturbance is not proposed.

Table 99-1 Change in elk winter feeding habitat suitability in the LAA during construction and dry operations

Habitat Suitability Rating	Existing Conditions	Construction	Dry Operations	Change from Existing Conditions to Construction					Change from Existing Conditions to Dry Operations				
	ha	ha	ha	Direct Permanent Disturbance (ha)	Temporary Disturbance (ha)	Indirect Disturbance (ha)	Total Disturbance (ha)	Total Disturbance (%)	Direct Permanent Disturbance (ha)	Temporary Disturbance (ha)	Indirect Disturbance (ha)	Total Disturbance (ha)	Total Disturbance (%)
High	223.0	106.1	151.9	-3.9	-53.7	-59.3	-116.9	-52.4	-3.9	0.0	-67.4	-71.0	-31.9
Moderate	1,016.7	640.0	777.9	-20.6	-106.3	-249.8	-376.7	-37.1	-20.6	0.0	-218.2	-238.8	-23.5

REFERENCES

Esser, L.L. 1994. *Elaeagnus commutata*. In: Fire Effects Information System. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Services Laboratory. Available at: https://www.fs.fed.us/database/feis/plants/shrub/elacom/all.html. Accessed: January 2020.

Gucker, C. 2012. *Cornus sericea*. In: Fire Effects Information System. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Services Laboratory. Available at: https://www.fs.fed.us/database/feis/plants/shrub/corser/all.html. Accessed: January 2020.

Hauser, A.S. 2007. *Symphoricarpos occidentalis*. In: Fire Effects Information System. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Services Laboratory. Available at: https://www.fs.fed.us/database/feis/plants/shrub/symocc/all.html. Accessed: January 2020.

Howard, J.L. 1996a. *Populus tremuloides*. In: Fire Effects Information System. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Services Laboratory. Available at: https://www.fs.fed.us/database/feis/plants/tree/poptre/all.html. Accessed: January 2020.

Province of Alberta. 2019. Conservation and Reclamation Regulation. Alberta Regulation 115/1993 with Amendments up to and including Alberta Regulation 198/2019. Current as of December 5, 2019. Alberta Queen's Printer, Edmonton Alberta. Available online: http://www.qp.alberta.ca/documents/Regs/1993_115.pdf

Question 100

Supplemental Information Request 1, Question 420, Page 6.140
Volume 3A, Section 11.4.2.3, Page 11.46

Alberta Transportation states *However, crop and hayland are expected to become tame pasture over time, which provides suitable wildlife habitat for grassland-dependent species*. Tame pasture habitat types have an extremely low habitat value relative to native plant communities for most wildlife species.

a. Explain the statement and assessment of "suitable" as referenced above when it is expected that the conversion of habitat will have significant adverse impacts (see Volume 3A, Section 11.4.2.3, Page 11.46).

b. In addition, explain the basis for this assumption and identify where habitat value losses are expected. Support this explanation with a detailed map.

c. Explain why restoration of private crop and hay land to native prairie as a conservation measure was not proposed to offset native habitat that will be adversely affected by this project.

Response

a. The statement in the EIA, Volume 3A, Section 11.4.2.3, is intended to indicate that tame pasture provides relatively higher suitability wildlife habitat *compared to crop and hayland*—not relative to native plant communities. Tame pasture provides relatively lower habitat suitability compared to native plant communities for most wildlife species; however, tame pasture can provide suitable habitat for some wildlife species, such as deer or elk, as well as grassland bird species that are habitat generalists (e.g., vesper sparrow, savannah sparrow). It is expected that after reclamation, tame pasture will increase wildlife habitat suitability compared to crop and hayland, based on the reclamation seed mix, which will provide potential food sources and plant cover for various grassland-dependent wildlife species.

The Project residual effects on change in habitat were considered in the determination of significance (see Volume 3A, Section 11.5), which states that with the application of mitigation and environmental protection measures, the residual environmental effects on wildlife are predicted to be not significant (i.e., the residual effects on change in habitat is unlikely to pose a long-term risk to the persistence or viability of a wildlife species in the RAA).

b. The assumption that some wildlife species use tame pasture is supported by the scientific literature related to habitat use of reclaimed areas or agricultural lands for various species. For example, savannah sparrow and other bird species (e.g., vesper sparrow) can breed in cultivated fields and lightly grazed pastures (Wheelwright and Rising 2008) and in reclaimed grasslands (Prescott and Murphy 1999). Pruvot et al. (2014) reported elk selected cattle pastures in southwestern Alberta depending on pasture and patch characteristics.

The distribution of land cover types affected by the Project is provided in Volume 3A, Section 10, Figure 10-3. The relative value of each land cover type in the LAA to support wildlife is assessed as part of habitat suitability modelling. The habitat suitability modelling results for key indicator wildlife species are presented in the habitat suitability maps (see Volume 3A, Section 11, Figures 11-3 to 11-10). The potential loss or alteration of wildlife habitat is shown for each key wildlife indicator species where the Project construction area overlaps high, moderate, low or very low/nil habitat suitability classes and the area (ha) affected is provided in Volume 3A, Section 11.4.2, Table 11-13 and Table 11-16.

Additional clarity regarding the locations of high and moderate suitability wildlife habitat for four key indicator species are provided in Figure 100-1 to Figure 100-5:

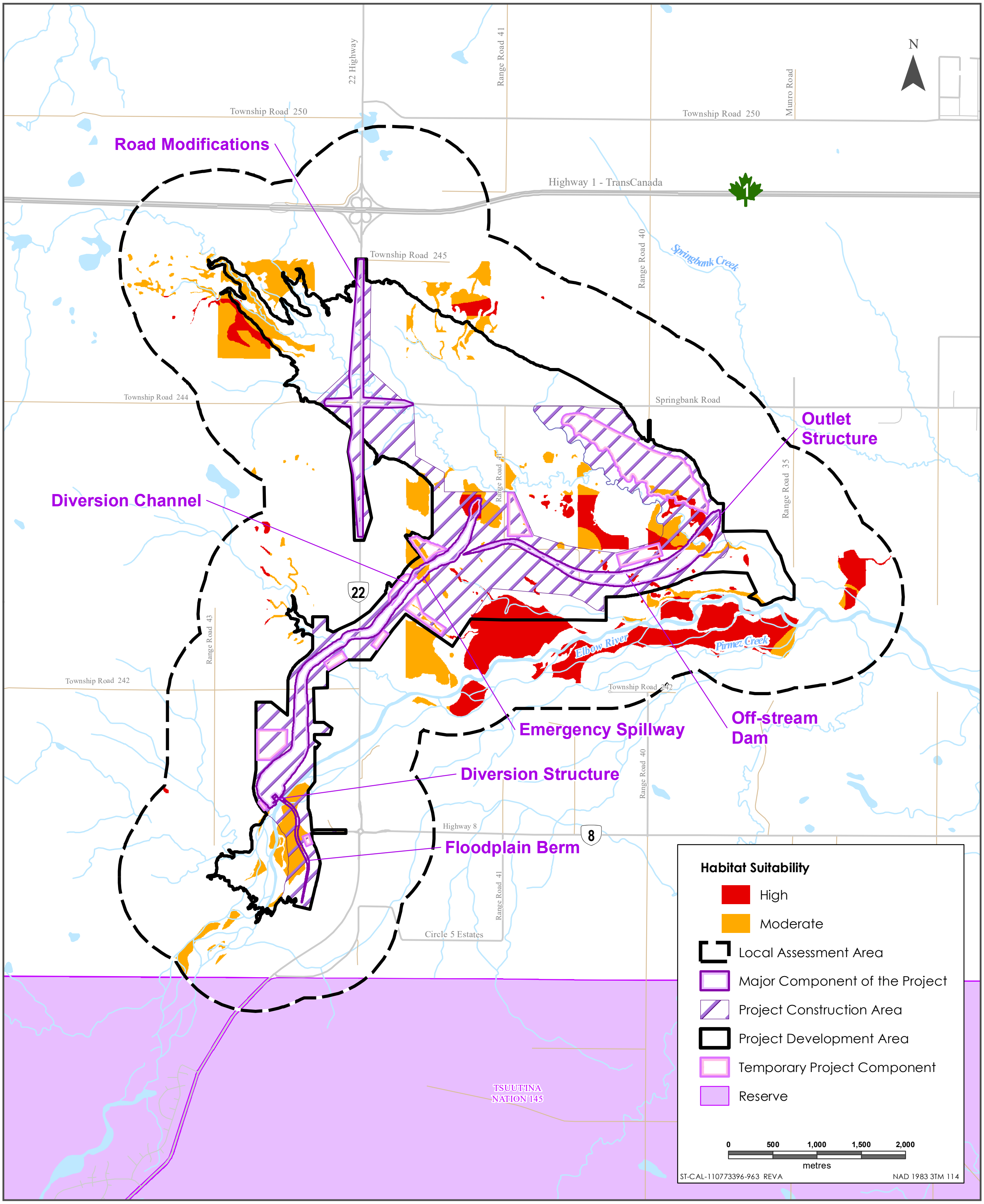
- grizzly bear spring feeding habitat suitability
- grizzly bear summer feeding habitat suitability
- olive-sided flycatcher habitat suitability
- northern leopard frog habitat suitability
- sora habitat suitability

The location of high and moderate suitability elk winter feeding habitat directly affected by the Project permanent structures is provided in the response to AEP Question 99, Figure 99-1. There is no high or moderate suitability breeding habitat for Sprague's pipit as described in Volume 3A, Section 11.2.2.4.

During construction and dry operations, the Project will directly and indirectly affect habitat for key wildlife indicator species. However, direct habitat loss associated with permanent Project components is relatively small for grizzly bear (spring feeding habitat; see Figure 100-1), olive-sided flycatcher (Figure 100-3), northern leopard frog (Figure 100-4) and sora (Figure 100-5). The Project will not affect high or moderate suitability summer feeding habitat for grizzly bear (Figure 100-2). Most of the area affected is due to indirect loss associated with sensory disturbance and temporary losses within the construction area, such as temporary Project components (i.e., temporary workspaces), which will be reclaimed.

c. As described in the response to AEP Question 99, restoration of habitat is not proposed because of the complexity involved in restoring habitat to conditions present prior to disturbance. Instead, reclamation (stabilizing sites, controlling pollution, improving visual conditions and facilitation future land use) is favored over restoration in the reservoir.

The Project revegetation plan has been developed to adaptively manage revegetation efforts, with the goal of revegetating high-quality areas with appropriate native seed mixes. There is greater likelihood of success with reclamation over restoration, and reclaimed areas will be supported by natural recovery, which is expected to occur over time. Hay and cropland areas will be reclaimed with the reclamation seed mix, which will provide potential food sources and plant cover for various grassland-dependent wildlife species. Alberta Transportation will consider recommended plant species by AEP to be included during reclamation to supplement natural re-vegetation of the area. These suggested plant species will be considered with those suggested by Indigenous groups.

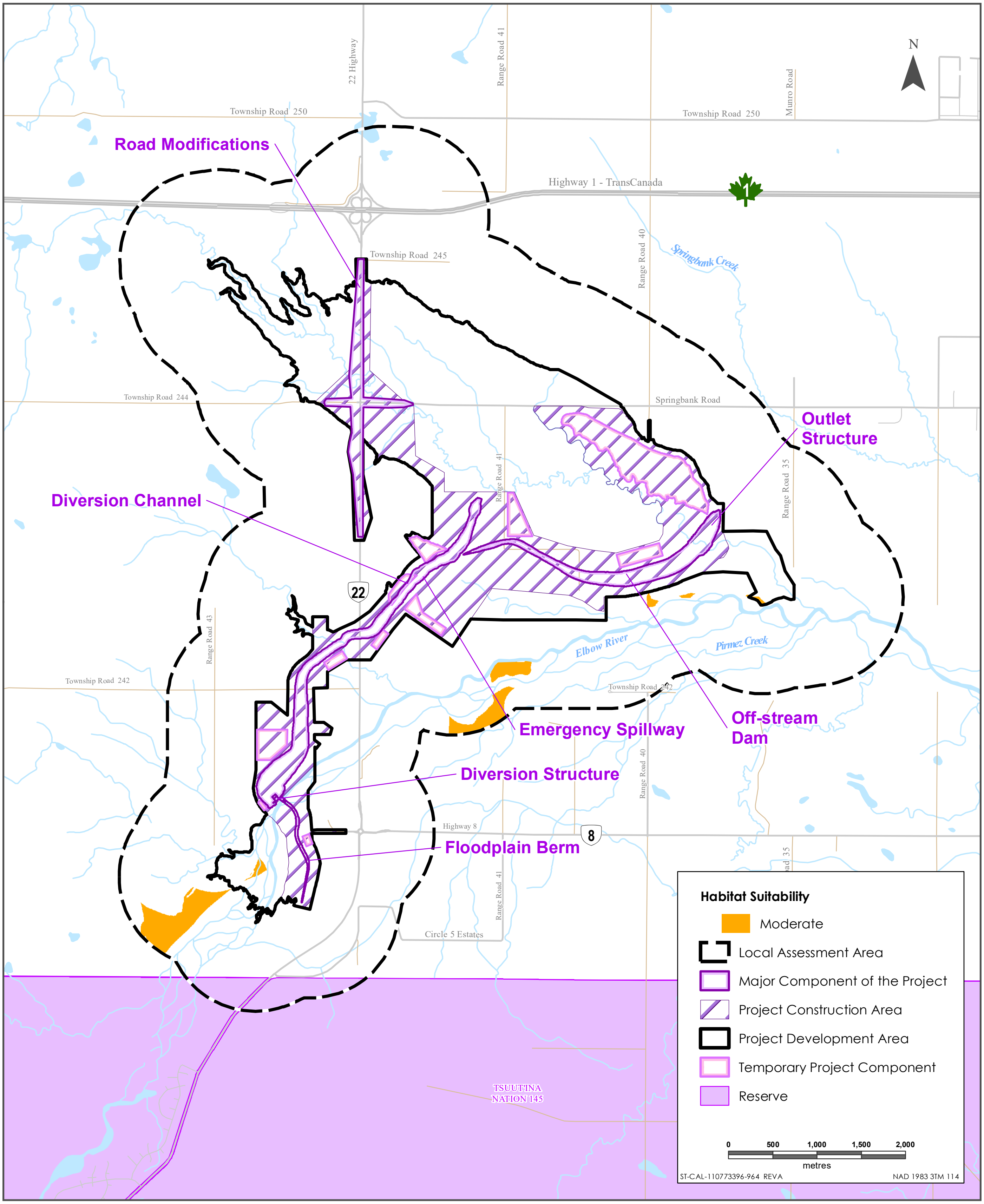


Sources: Base Data - Government of Alberta, Government of Canada, Thematic Data - Stantec Ltd.

Grizzly Bear Spring Feeding Habitat Suitability in the LAA – Existing Conditions

Stantec

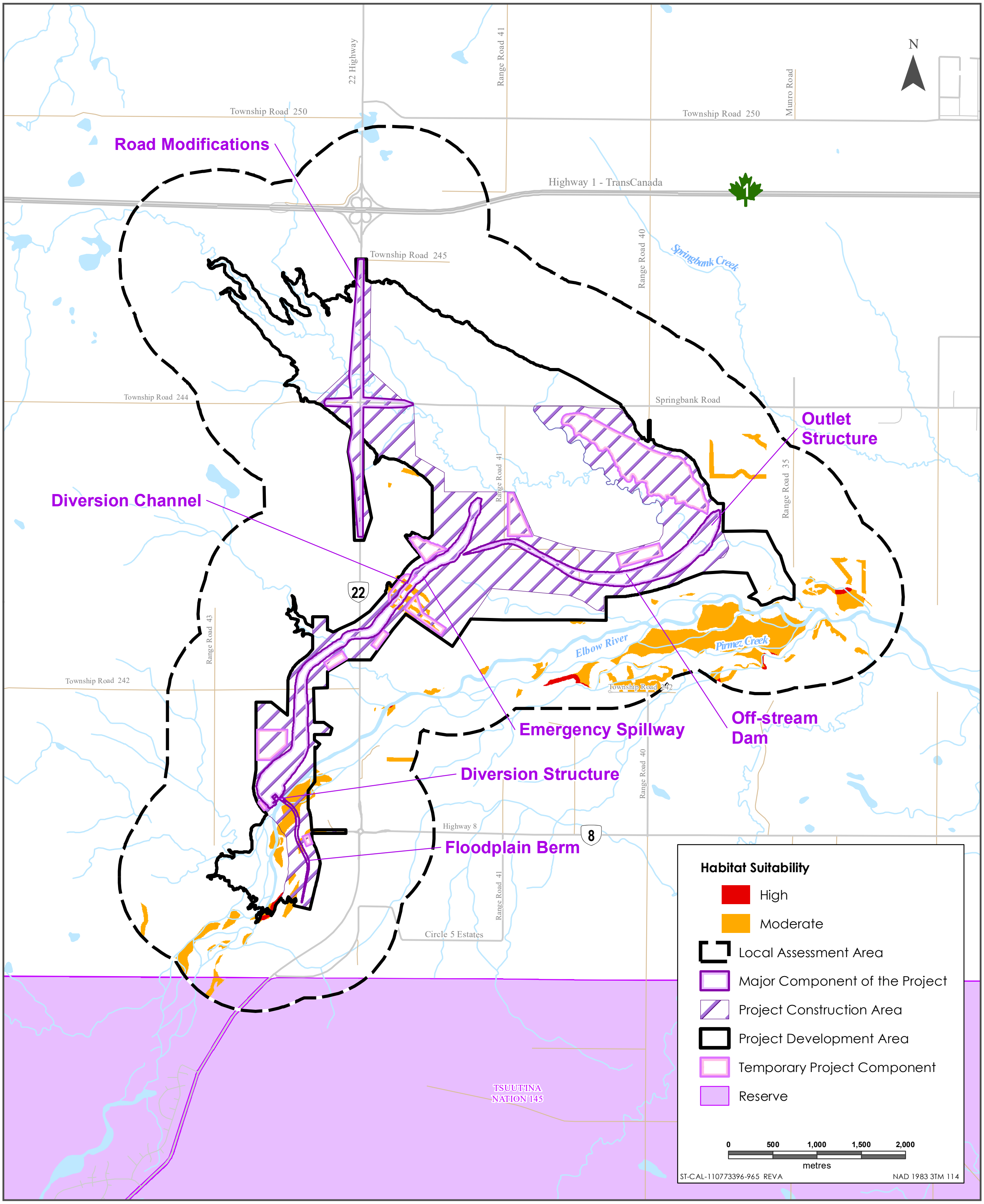
Figure 100-1



Sources: Base Data - Government of Alberta, Government of Canada, Thematic Data - Stantec Ltd.

Grizzly Bear Summer Feeding Habitat Suitability in the LAA – Existing Conditions

Stantec

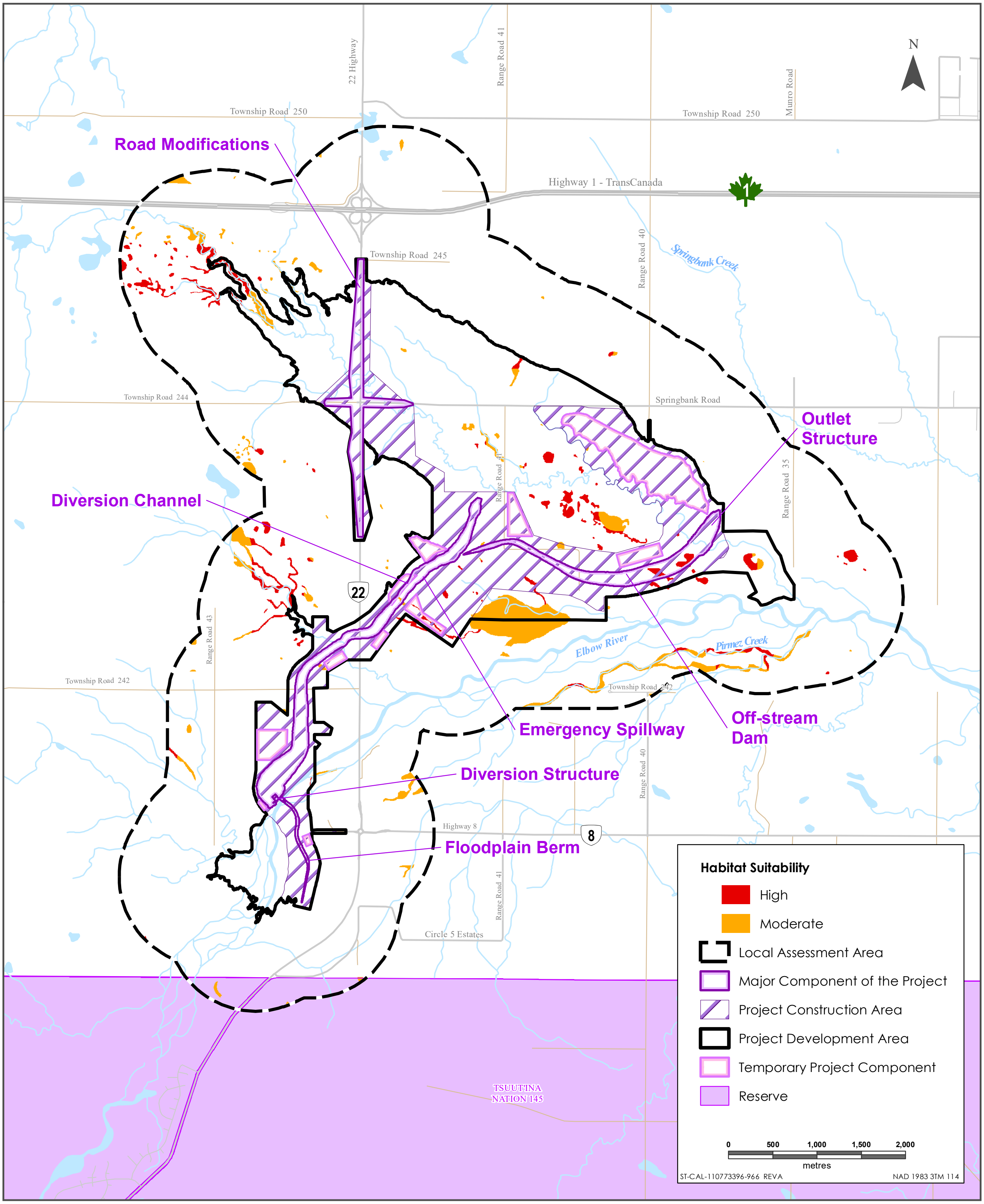


Sources: Base Data - Government of Alberta, Government of Canada, Thematic Data - Stantec Ltd.

Olive-Sided Flycatcher Habitat Suitability in the LAA – Existing Conditions

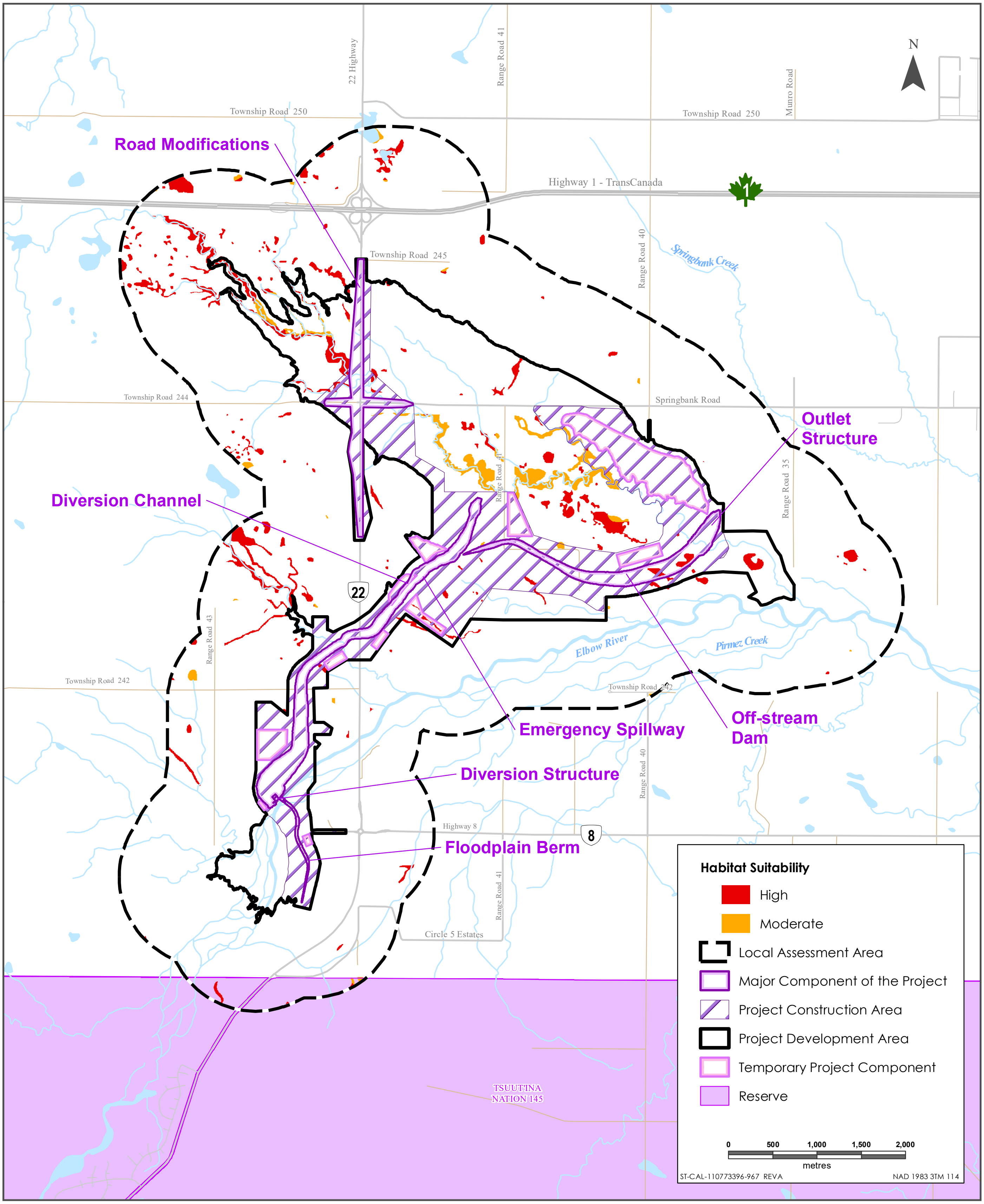
Stantec

Figure 100-3



Sources: Base Data - Government of Alberta, Government of Canada, Thematic Data - Stantec Ltd.

Northern Leopard Frog Habitat Suitability in the LAA – Existing Conditions



Sources: Base Data - Government of Alberta, Government of Canada, Thematic Data - Stantec Ltd.

Sora Habitat Suitability in the LAA – Existing Conditions

Stantec

Figure 100-5

REFERENCES

Prescott, D. R. C., and A. J. Murphy. 1999. Bird populations of seeded grasslands in the aspen parkland of Alberta. In Ecology and Conservation of Grassland Birds of the Western Hemisphere (P. D. Vickery and J. R. Herkert, Editors). Studies in Avian Biology 19:203-210.

Pruvot, M., D. Seidel, M.S. Boyce, M. Musiani, A. Massolo, S. Kutz, and K. Orsel. 2014. What attracts elk onto cattle pasture? Implications for inter-species disease transmission. P*reventative Medicine* 117: 326-339.

Wheelwright, N. T. and J. D. Rising. 2008. Savannah Sparrow (*Passerculus sandwichensis*), version 2.0. In the Birds of North America (A. F. Poole, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bna.45

Question 101

Supplemental Information Request 1, Question 421, Page 6.412

This response contradicts other sections of the EIA which acknowledge that sedimentation will destroy native communities and will require sediment removal and reseeding which cannot replace native grasslands.

Native seeding may not restore native grasslands and the statements made in reference to this may be misleading and misrepresenting regarding the assumed impacts to native habitat, habitat loss and replacement estimates.

a. **Explain why Alberta Transportation does not acknowledge this loss and long term reduction in habitat values when native habitat is disturbed.**

b. **Explain if it is possible to increase the native grassland by 90.6 ha during dry operations if it is expected that some of this area will be modified, and cannot be restored, or may take decades to recover.**

c. **Explain these assumptions and clarify and correct the contradicting statements in the EIA.**

d. **Confirm that the methods used do not establish the confidence or ability to predict impacts. Explain why Alberta Transportation chose to limit its ability to inform this assessment.**

Response

a. The assessment does acknowledge that during construction the Project will result in the alteration and loss of habitat including native grassland (see EIA, Volume 3A, Section 10.4.3; Volume 3B, Section 10.2.2; Volume 3A, Section 11.4.2.3, and Volume 3B, Section 11.3.2). The permanent and long-term loss of habitat, such as native grassland, will occur where there is overlap with permanent Project structures (e.g., diversion channel). However, reclamation of the construction area will result in changes that will vary. Grasslands are expected to re-establish within three years but resemble early seral communities for 12 years or more beyond construction. Tree and shrub communities will become grassland with trees and shrubs establishing naturally in time.

   The assessment also acknowledges that sediment deposition will reduce habitat suitability depending on sediment depth during post-flood operations (see Volume 3B, Section 11.3.2.3). Although this sediment deposition will temporarily reduce habitat suitability in the reservoir, it is expected these areas will be recolonized by vegetation from the surrounding area and seeded if revegetation targets are not met. Therefore, a long-term reduction in habitat value is not expected, especially for areas that receive less than 10 cm of sediment; however, areas that might receive deeper sediment (e.g., 10 cm to 100 cm or greater than 1 m) would require a longer recovery time for habitat to become suitable for wildlife. See the response to AEP Question 102 for details on expected vegetation recovery following floods.

   The assessment of post-flood operations incorrectly stated effects would be medium-term on vegetation and wetlands (Volume 3B, Section 10.2.5, Table 10-13) and short-term on wildlife and biodiversity (Volume 3B, Section 11.3.7, Table 11-7), sora (Volume 3B, Section 11.3.7, Table 11-9), and migratory birds (Volume 3B, Section 11.3.7, Table 11-11). However, based on the duration definition outlined in Volume 3B, Section 11.1.1.1, effects should have been listed as short-term (i.e., limited to flood operations) to long-term (i.e., extend beyond flood operations). Updated versions of Tables 10-13, 11-7, 11-9 and 11-11 are provided in Table 101-1 to Table 101-4 with the revisions highlighted in **red**.

   The determination of significance for vegetation and wetlands, as well as for wildlife and biodiversity, remains unchanged because although the duration of the effect might be long-term based on the estimated recovery time for areas that receive deeper sediment, the Project is still not expected to threaten the long-term persistence or viability of a plant species, community or wildlife species in the RAA. As discussed in the response to AEP Question 102, grassland communities should re-establish within three years, tree and shrub communities would be composed of 3 m tall trees and shorter shrubs about 10 years post-flood, 5 m tall trees about 20 years post-flood and 13 m tall trees about 50 years post-flood.

Table 101-1 Project Residual Effects on Vegetation and Wetlands during Flood and Post-Flood Operations

Residual Effect	Residual Effects Characterization								
	Project Phase	Timing	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in Community Diversity	F/PF	N/A	A	L	PDA	ST/LT	S	R	D
Change in Species Diversity	F	N/A	A	M	PDA	LT	S	I	D
Change in Wetland Functions	F/PF	N/A	A	M	PDA	ST/LT	S	R	D

KEY

See Table 10-2 in Volume 3A of the EIA for detailed definitions

Project Phase
F: Flood Operation
PF: Post-flood Operation

Timing Consideration
S: Seasonality
T Time of day
R: Regulatory

Direction
P: Positive
A: Adverse
N: Neutral

Magnitude
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration
ST: Short-term
LT: Long-term

N/A: Not applicable

Frequency
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility
R: Reversible
I: Irreversible

Ecological/Socio-Economic Context
D: Disturbed
U: Undisturbed

Table 101-2 Project Residual Effects on Wildlife and Biodiversity during Flood and Post-Flood Operations

Residual Effect	Residual Effects Characterization								
	Project Phase	Timing	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic
Change in habitat	F	S	A	N-H	LAA	ST	IR	R	D
	PF	S/R	A	N-M	LAA	**LT**	IR	R	D
Change in movement	F	S	A	N-M	LAA	ST	IR	R	D
	PF	N/A	A	L-M	LAA	**LT**	IR	R	D
Change in mortality risk	F	S	A	N-M	PDA	ST	IR	R	D
	PF	S/R	A	N-M	RAA	**LT**	IR	R	D
Change in biodiversity	F	S	A	N	N/A	N/A	N/A	N/A	N/A
	PF	N/A	A	N	N/A	N/A	N/A	N/A	N/A
Change in wildlife health	F	S	A	N	N/A	N/A	N/A	N/A	N/A
	PF	N/A	A	N	N/A	N/A	N/A	N/A	N/A

KEY
See Table 11-5 in Volume 3A of the EIA for detailed definitions

Project Phase
F: Flood Operation
PF: Post-flood Operation

Timing Consideration
T: Time of day
S: Seasonality
R: Regulatory

Direction
P: Positive
A: Adverse
N: Neutral

Magnitude
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration
ST: Short-term
LT: Long-term

Frequency
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility
R: Reversible
I: Irreversible

Ecological and Socio-Economic Context
D: Disturbed
U: Undisturbed

N/A: Not applicable

Table 101-3 Project Residual Effects on Sora during Flood and Post-Flood Operations

Residual Effect	Residual Effects Characterization								
	Project Phase	Timing	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in habitat	F	S	A	H	LAA	ST	IR	R	D
	PF	S/R	A	M	LAA	LT	IR	R	D
Change in movement	F	N/A	A	L	LAA	ST	IR	R	D
	PF	N/A	A	L	LAA	LT	IR	R	D
Change in mortality risk	F	S	A	M	PDA	ST	IR	R	D
	PF	S/R	A	L	PDA	LT	IR	R	D
Change in wildlife health	F	S	A	N	N/A	N/A	N/A	N/A	N/A
	PF	N/A	A	N	N/A	N/A	N/A	N/A	N/A

KEY
See Table 11-5 in Volume 3A of the EIA for detailed definitions

Project Phase
F: Flood Operation
PF: Post-flood Operation

Timing Consideration
T: Time of day
S: Seasonality
R: Regulatory

Direction
P: Positive
A: Adverse
N: Neutral

Magnitude
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration
ST: Short-term
LT: Long-term

Frequency
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility
R: Reversible
I: Irreversible

Ecological and Socio-Economic Context
D: Disturbed
U: Undisturbed

N/A: Not applicable

Table 101-4 Project Residual Effects on Migratory Birds during Flood and Post-Flood Operations

Residual Effect	Residual Effects Characterization								
	Project Phase	Timing	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in habitat	F	S	A	L-M	LAA	ST	IR	R	D
	PF	S/R	A	L-M	LAA	**LT**	IR	R	D
Change in movement	F	N/A	A	L-M	LAA	ST	IR	R	D
	PF	N/A	A	L-M	LAA	**LT**	IR	R	D
Change in mortality risk	F	S	A	L-M	PDA	ST	IR	R	D
	PF	S/R	A	L	PDA	**LT**	IR	R	D
Change in wildlife health	F	S	A	N	N/A	N/A	N/A	N/A	N/A
	PF	N/A	A	N	N/A	N/A	N/A	N/A	N/A

KEY

See Table 11-5 in Volume 3A of the EIA for detailed definitions

Project Phase
F: Flood Operation
PF: Post-flood Operation

Timing Consideration
S: Seasonality
T: Time of day
R: Regulatory

Direction
P: Positive
A: Adverse
N: Neutral

Magnitude
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration
ST: Short-term
LT: Long-term

N/A: Not applicable

Frequency
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility
R: Reversible
I: Irreversible

Ecological and Socio-Economic Context
D: Disturbed
U: Undisturbed

b. The analysis does not assume restoration of species composition to pre-disturbance, but it assumes areas will be reclaimed to a native grassland community dominated by native grasses and other native plant species, which will provide potential feeding habitat for ungulates (e.g., deer, elk). Volume 3A, Section 10, Table 10-12 shows an increase of 90.6 ha of native grassland following construction; much of this is the result of the removal of tree and shrub layers from forested and shrubland communities during construction and following floods. The areas are classed as native grassland because it is expected native grasses will be present or re-establish with proposed mitigation following construction and floods. Native species will be seeded where ground vegetation is below desired reclamation targets following construction or floods.

c. The EIA vegetation assessment and Alberta Transportation's response to Round 1 AEP IR421 do not contradict. Both documents identify a reduction in the area of forested and shrubland communities and changes in the abundance of native grassland. Existing native fescue grassland will be reduced by 8.9 ha following construction and native grassland area will increase by 90.6 ha due to the removal of trees and shrubs from forested and shrubland communities (Volume 3A, Section 10.4.3, Table 10-12 and Volume 3B, Section 10.2.2). Existing native communities affected by construction or floods are expected to remain as native communities following application of mitigation, including reclamation, although species composition may differ from pre-disturbance. Reclamation will target the re-establishment of native communities affected by construction and flood events (see Alberta Transportation's response to Round 1 AEP IR407, Appendix 407-1), which will provide potential feeding and nesting habitat for grassland dependent wildlife species. If native seeding alone cannot achieve reclamation targets in temporarily disturbed native communities then reclamation will be adjusted following an adaptive management approach. Tree and shrub species are expected to naturally re-establish in time following construction and flood events.

d. The methods used for the vegetation assessment and the wildlife assessment are in alignment with accepted environmental assessment methods in Alberta and are appropriate to predict Project residual effects. The ability to predict effects does not require the identification of all plant species that may establish in areas disturbed by the Project. As described above, vegetation is expected to establish with mitigation shortly after construction and flood events. A return of pre-disturbance communities is not expected; however, communities dominated by native plants will occur and these communities are expected to provide suitable habitat for wildlife. Prediction confidence is assessed as moderate for vegetation and moderate for wildlife (see Volume 3B, Section 10.4 and Volume 3B, Section 11.5 for flood and post-flood effects). Project mitigation (e.g., post construction and operation reclamation and monitoring, seed mix application, and adaptive management) are expected to promote the establishment of native vegetation communities following construction and floods. Effects are expected to be long-term for wildlife habitat as habitat features (e.g., cover and nesting tree and shrub communities) will occur over several years.

Question 102

Supplemental Information Request 1, Question 422, Page 6.144

The response indicates that reestablishment of habitat will take 10 years or longer. This long term impact has not been discussed in the EIA.

a. Explain the reduction in habitat values that are expected to persist >=10, 20, >50 years or longer. Provide a map to illustrate these areas in detail.

Response

a. Changes in habitat values due to post-flood sediment deposition will depend on sediment depths within the reservoir, habitat type affected, and its relative value to specific wildlife species. As discussed in the EIA, Volume 3B, Section 10.2.2.3, tame pasture will be the most affected habitat type (69.5 ha) due to floods and sedimentation 10 cm or greater (see Volume 3B, Section 10.2.2.3, Table 10-11). Dominant species of the proposed agronomic seed mix, pubescent wheat grass (*Agropyron trichophorum*) and Dahurian wildrye (*Elymus dahuricus*), establish quickly (Tilley and St. John 2014; USDA 2018) and will likely provide ground cover within one growing season or sooner. Sheep fescue (*Festuca ovina*), another dominant plant of the agronomic seed mix, may require two to three years to mature (Ogle et al. 2010). These areas will provide potential feeding habitat for ungulates such as deer and elk and nesting habitat for grassland-dependent birds (e.g., savannah sparrow) in a relatively short time period. Therefore, effects of sediment deposition on habitat suitability values for these species are not expected to persist for greater than 10 years.

Existing dominant grass and forb species are expected to disperse from surrounding areas or establish from the seedbank, rhizomes or root fragments. Smooth brome, a dominant grass of tame pasture areas of the PDA, reproduces by rhizomes, seed and tillers (Howard 1996b) and quackgrass, another dominant non-native grass of tame pasture area of the PDA, reproduces primarily by rhizomes, but also by seed (Snyder 1992). Smooth brome can be slow to establish (USDA 2006c) and quackgrass establishes quickly (USDA n.d); both species are expected to readily re-establish following floods and be abundant within two years following disturbance of tame pasture areas. Approximately 80 smooth brome plants per m^2 were observed within one year by Woodis and Jackson (2008) when lab grown, and Deutsch et al. (2010) observed percent cover increase by more than 400% within a year when grown in situ.

Buried native grass communities will likely establish shortly after flooding in reservoir areas with less than 10 cm of sediment and with seed mix application in areas of deeper sedimentation. Two of the seed mix species, slender wheatgrass (*Elymus trachycaulum*) and northern wheatgrass (*Agropyron dasystachyum*) establish and provide cover quickly (USDA 2006a, b) and other species, such as tufted hairgrass (*Deschampsia cespitosa*) typically establish within one to two years (USDA 2009). These areas will also provide potential feeding habitat for ungulates such as deer and elk and nesting habitat for grassland-dependent birds (e.g., savannah sparrow) likely within three years. Areas may, however, resemble earlier seral communities beyond 12 years after flooding. Late seral grassland communities have been observed 11 years to 12 years after minimal disturbance pipeline construction in southern Alberta (Lancaster et al. 2012); however, community alteration from the Project is expected to be higher magnitude and take longer to recover.

A reduction in shrub cover is expected following a 1:10 year flood, and shrub and tree cover following a 1:100 year flood and design flood. Snowberry (*Symphoricarpos occidentalis*), rose (*Rosa acicularis*), Bebb's willow (*Salix bebbiana*), and sandbar willow (*Salix exigua*) are dominant shrub species of potentially affected communities, and trembling aspen (*Populous tremuloides*) and balsam poplar (*Populous balsamifera*) are dominant tree species. These shrub and tree species regenerate primarily from buried rhizomes, roots or shoots (Tesky 1992; Crane 1990; Hauser 2007; Harris 1990; Howard 1996a; Anderson 2006) and are expected to quickly establish following floods if sediment depths are less than 10 cm. Areas that contain these shrub species will provide potential foraging habitat (i.e., browse) for ungulates, such as deer and elk, and security cover for various wildlife species, depending on shrub density.

Growth rates for all of the dominant tree and shrub species potentially affected by the Project were not identified from a literature review; however, snowberry can grow to a height of 9 cm to 18 cm in a single season (Hauser 2007) and readily regrows from rhizomes (McCarty 1967) and existing crowns (Romo et al. 1993). Aspen seedlings can grow up to 61 cm in a single growing season (Howard 1996a); however, average aspen growth rates are about 26 cm (Howard 1996a). Growth rates will vary in response to sediment depth (Frey et al. 2002), climatic conditions (Anyomi et al. 2012) and herbivory (Rhodes et al. 2018). Small stemmed trees and short shrubs are expected to establish in the first few years following floods with stands thinning within the first five to six years following a flood. Assuming a growth rate of 26 cm per year for aspen and balsam poplar, areas of complete tree loss would be composed of approximately 3 m tall trees and shorter shrubs about 10 years post-flood, 5 m tall trees about 20 years post-flood and 13 m tall trees about 50 years post-flood. In these areas, regenerating aspen and balsam poplar would provide potential nesting habitat for bird species associated with early seral aspen stands (Jarvi et al. 2018; Schieck and Song 2006; Hobson and Bayne 2000) and security cover for ungulates (e.g., deer, elk) in 10 to 20 years, depending on stem density (DeByle 1985). Tree and shrub re-establishment in areas with 10 cm or deeper sediment, will likely occur over a longer period and have lower densities. Because shrubs and trees will take relatively longer to re-establish in areas with 10 cm or deeper sediment, habitat suitability for wildlife species that use shrubs or trees for feeding or cover (e.g., deer, elk) or for nesting (e.g., alder flycatcher, least flycatcher, olive-sided flycatcher) will be reduced over a longer time period.

Wetlands are expected to persist following 1:10, 1:100 and design floods in areas with less than 10 cm of sediment, although plant composition may be altered. These areas will provide potential breeding and feeding habitat for wetland-dependent wildlife, such as waterfowl, waterbirds and amphibians. Shrubby swamps are expected to temporarily change to graminoid marshes following floods due to the loss of shrubs. Shrubs should re-establish naturally in less than 10 years because two of the dominant species, Bebb's willow and flat-leaved willow (*Salix planifolia*), reproduce rapidly by roots and seeds (Tesky 1992; Uchytil 1991). Information on the regeneration of basket willow (*Salix petiolaris*), another dominant shrub, was not found.

Sediment depths greater than 10 cm are expected to result in the loss of grasses, forbs and short shrubs. Grasses, sedges, forbs and shrubs are expected to re-establish in less than 10 years, provided post-flood topography supports wetland conditions, but cover may be lower than areas of shallower sediment. Dominant wetland sedges in the reservoir include water sedge (*Carex aquatilis*) and woolly sedge (*Carex pellita*) and common grasses include tufted hair grass (*Deschampsia cespitosa*) and Kentucky bluegrass (*Poa pratensis*). Water sedge and woolly sedge reproduce by seed and rhizome, and readily colonize disturbed areas (Hauser 2006; Flora of North America n.d.). Tufted hair grass and Kentucky bluegrass also frequently occur on disturbed sites (Walsh 1995; Uchytil 1993). New wetlands may also naturally establish in areas of suitable topography.

Overall, a reduction in habitat value that will persist for more than 10 years will only occur in areas that contain shrub and treed habitat. Habitat suitability for specific wildlife species will return to suitable conditions as succession progresses over the short and long-term. As described in the response to AEP Question 99a, restoration of these areas to conditions identical to those prior to disturbance is not proposed. Changes in vegetation cover due to flooding and sedimentation ten years, 20 years and 50 years after a design flood are shown in Figures 102-1, 102-2 and 102-3. Vegetation pre-design flood equals conditions established immediately following Project construction (i.e., forested and shrubland communities intersected by construction area are converted to native grassland). Wetland abundance in areas of 10 cm or greater sediment may also be different than displayed due to changes in topography post design flood.

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Question 103

Supplemental Information Request 1, Question 423, Page 6.145

Alberta Transportation states *Long-term changes in habitat conditions, such as scouring, plant cover, woody debris, supporting habitat functions (e.g., food sources, shelter), and health in downstream habitat are therefore also not expected to change in a meaningful way*.

a. Explain how limiting the Elbow River flow downstream of the diversion structure to 160m^3/s will influence riparian habitat health downstream of the diversion channel to the Glenmore Reservoir and beyond.

b. Provide a map of the riparian habitat expected to receive and not receive overland flooding at 160, 200, 250, and 300 m^3 flow rates. Explain how this modification of flow will affect the riparian health and function of affected wildlife habitat downstream of the project area to the distance expected to be influenced.

c. Explain in detail how something can change but not in a meaningful way. Define the term “meaningful” in both relative and absolute terms and provide examples to illustrate this as it relates to the question.

Response

This response will be included in a future filing.

Question 104

Supplemental Information Request 1, Question 426, Page 6.147

Alberta Transportation states that *the draft wildlife mitigation and monitoring plan…for construction and dry operations focuses on large mammals (e.g., deer, elk, grizzly bear) because they are species of management concern (SOMC) that are most likely to be affected by the Project through changes in movement and have the greatest uncertainty regarding responses to Project components.*

a. Explain how they have the greatest uncertainty and identify why these uncertainties remain.

b. How can these uncertainties be addressed via the post construction-monitoring plan?

Response

a. The greater uncertainty for large mammals such as deer and elk is related to the expectation that deer and elk are more likely to interact with Project structures more frequently based on the results of the baseline wildlife surveys completed in the LAA (see the EIA, Volume 4, Appendix H, Section 3.6 and Section 3.7).

   Some uncertainty associated with Project residual effects on change in wildlife movement remains because there is limited information on how wildlife such as deer and elk might respond to the presence of permanent Project structures, such as the diversion channel. Similarly, some uncertainty exists with respect to the effectiveness of certain mitigation measures, such as the filled riprap in the diversion channel because there is limited information available on how deer and elk might respond to these mitigation measures.

   The final WMMP will be developed in discussion with regulators and consultation with Indigenous groups and will be designed to evaluate whether Project structures such as the diversion channel create barriers to wildlife movement in the LAA.

b. The uncertainties associated with Project residual effects on change in wildlife movement will be addressed as part of the final WMMP, which will be implemented within an adaptive management framework. The results of the remote camera monitoring program (e.g., crossing success rates at bridge underpass, diversion channel or wildlife friendly fencing) will be used to verify predictions and evaluate the success of proposed mitigation. Where necessary, adjustments or improvements will be made to mitigation measures so that specific mitigation objectives (and targets) related to wildlife movement are met. These mitigation objectives and targets will be identified in the final WMMP.

Question 105

Supplemental Information Request 1, Question 427, Page 6.148

Alberta Transportation states *Given these mitigation measures, the Project will have no significant effects on wildlife habitat, movement, and mortality risk, and will not threaten the long-term persistence or viability of wildlife in the wildlife RAA. Based on this, no further mitigation for biodiversity is required.*

a. Explain the additional benefit if all disturbed habitats were restored to native habitat and conservation tools such as offset measures on adjacent lands were used.

b. Explain how unforeseen protected wildlife and/or habitat features will be dealt with if they are detected (e.g. nests or dens)?

c. Explain if an assessment of impact on wildlife values was completed for non-dam related post construction end land uses (e.g. recreation and access). If not, explain why not.

Response

a. If all existing disturbed land types (anthropogenically modified and agricultural) in the PDA and areas disturbed by the Project were restored, the abundance of native communities, and possibly species diversity, would likely increase. The greatest change would likely be the abundance of grassland and shrubby communities. Native forest would likely also increase over time. An increase in native grassland and shrub communities in the PDA could provide additional benefits such as increased vertical structure (cover) and habitat quality for certain wildlife species including species at risk that are dependent on intact native prairie (e.g., Sprague's pipit). However, there are challenges associated with habitat restoration, as discussed in response to AEP Question 99, and restoration is not proposed.

It is expected that, over time, reclamation of the PDA will provide suitable habitat for wildlife species that utilize grasslands such as elk, deer and grassland songbirds (e.g., savannah sparrow). With the application of mitigation, including the proposed reclamation, the Project will not threaten the long-term persistence or viability of wildlife species in the RAA.

The potential benefits of offsets typically include no net loss or a net gain of habitat, which can be achieved through restoration or protection of areas outside the disturbed lands (i.e., avoided loss) (Moilanen and Kotiaho 2018). Securing additional land outside the PDA to offset Project development may increase the abundance of shrubby and forested areas in the RAA because these species recolonize currently anthropogenically modified areas. Most of the RAA has been converted to tame pasture and agriculture (Figure 105-1); without active reclamation efforts in offset areas, native grasses and forbs are not likely to be dominant in anthropogenically modified areas because non-native grasses are aggressive competitors (USDA 2006; Tannas 2003).

Offset measures are not proposed, as discussed in Alberta Transportation's response to Round 1 CEAA Package 2 IR2-17d, which states:

"Habitat offsets were not considered as a mitigation option for the direct loss of wildlife habitat including elk habitat because:

- There is no provincial offset policy or framework in place to allow for the consideration of offsets as a mitigation option for proposed developments.
- Currently, habitat offsets are only applied to wetlands as part of the *Alberta Wetland Mitigation Directive* (GoA 2018) or to wildlife species listed as endangered or threatened under Schedule 1 of the *Species at Risk Act* (SARA). Offsets under SARA are used only to address residual effects after applying avoidance and mitigation measures to comprehensively reduce the effects of the activity on species at risk individuals, residences and critical habitat (GoC 2016).
- Elk are currently listed as secure by AEP (2017) and are not listed as endangered or threatened under Schedule 1 of SARA (GoC 2019). There is currently no precedence for designating habitat-based offsets for a non-listed species.

Overall, habitat offsets were not considered as a mitigation option because the proposed mitigation strategies (e.g., avoid, minimize, reclaim, as well as Project design features) were determined to be adequate to reduce Project residual effects on wildlife habitat and elk movement to the extent that they do not threaten the long-term persistence or viability of wildlife including elk in the RAA (i.e., there is substantial habitat for elk in the RAA), as well as in consideration for the other reasons listed above. The Project will reclaim temporary workspaces using native species, which will reduce the direct loss of high and moderate suitability elk feeding habitat within the construction area."

b. As described in Volume 3A, Section 11.4.2.2, as well as in the draft WMMP, pre-construction surveys will be conducted to identify wildlife features (e.g., nests, dens) and appropriate site-specific mitigation developed.

c. The Draft Guiding Principles and Direction for Future Land Use (see the response to AEP Question 87, Appendix 87-1) identified secondary uses and activities that have minimal impact on the land will be allowed (primary uses being flood mitigation). These low intensity activities and non-motorized access (e.g., hiking), suggests relatively low potential effects on wildlife and wildlife habitat. Although Alberta Transportation is aware that the PDA is currently being accessed by Indigenous groups, the extent and frequency to which the PDA is currently being accessed by Indigenous groups for traditional purposes such as hunting is unknown; therefore, it is difficult to determine if increased access to lands by Indigenous groups would result in an incremental increase in mortality risk to ungulates (e.g., deer, elk) due to hunting. As the land use principles are finalized, Alberta Transportation will continue to evaluate the potential effects of Indigenous groups use of the land and wildlife resources.

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Question 106

Supplemental Information Request 1, Question 428, Page 6.153

a. Explain and assess the adequacy and inadequacies of the proposed post construction-monitoring plan.

b. Explain if the timelines and methods proposed will enable clearly stated monitoring objectives to yield robust conclusions as per the last statement of this SIR response.

c. How does the proposed methods align with respect to similar monitoring programs effectiveness and designs used in other EIAs and wildlife mitigation and monitoring programs in Alberta?

Response

a. The draft WMMP is considered adequate to meet the stated mitigation and monitoring objectives and aligns with WMMPs completed for other similar approved projects. The final WMMP will be developed in consultation with provincial and federal regulators, as well as with Indigenous groups following Project approval. The adequacy of the WMMP will be assessed as part of the collaborative stakeholder and Indigenous engagement program. To ensure the WMMP is implemented in an effective manner, the identification of specific goals and objectives as well as an evaluation of study design will be discussed, including any limitations related to the monitoring study design.

b. Yes, the draft WMMP has identified goals and objectives that are linked to mitigation and monitoring, which will provide a robust evaluation framework. As stated in the response to a., the final WMMP will identify specific objectives and goals to address potential Project effects. The study design will include appropriate monitoring methods and performance measures designed to evaluate the effectiveness of proposed mitigation. The final WMMP will address the duration of the monitoring program, as well as identify reporting timelines. The WMMP will provide useful information to evaluate the accuracy of predictions and effectiveness of proposed mitigation.

c. Although the scope of WMMPs will vary with each type of project, the approach and methods outlined in the draft WMMP are similar to WMMPs completed for other projects in Alberta that are designed to evaluate the effectiveness of mitigation measures implemented to reduce potential project effects such as change in habitat, wildlife movement and mortality risk (Cenovus 2012; Statoil 2012).

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Question 107

Supplemental Information Request 1, Question 429, Page 6.155

The project should adhere to Environment and Climate Change Canada's (ECCC) habitat clearing recommendations for sediment removal during nesting periods and be in accordance with the *Migratory Bird Convention Act.*

a. Confirm that clarity will be the obtained from the ECCC regarding the habitat clearing guideline.

Response

a. Sediment removal from the reservoir is not anticipated, although it is on the spectrum of remediation options (see the response to AEP Question 84).

   Grading may occur to move the sediment away from areas where it affects the functionality of the Project components or blocks drainage (see Alberta Transportation's response to Round 1 AEP IR382). Alberta Transportation is aware of Environment and Climate Change Canada (ECCC) guidelines to reduce risk to migratory birds. As discussed in the EIA, Volume 3B, Section 11.3.8.2, if sediment partial clean-up activities are planned in the reservoir during the RAP for migratory birds, a qualified wildlife biologist will conduct a bird nest search to manage the risk of harm to nesting migratory birds. Alberta Transportation and AEP (as the operator) are aware of the *Migratory Birds Convention Act* and will communicate with ECCC, as needed, for construction and operations.

Question 108

Supplemental Information Request 1, Question 432, Page 6.189

Restoration of native habitat is very difficult and it is noted that the term reclamation is not equivalent to restoration.

a. Explain and assess if the stated conclusions on habitat modification impacts are underestimated to a degree that they cannot be informed via the assessment methods contained in the EIA.

Response

a. Habitat suitability models assess the ability of each habitat type (ecosite phase) to provide the necessary life requisites (e.g., food, cover) to meet seasonal habitat requirements using a four-class rating scheme: Class 1 = high habitat value; Class 2 = moderate habitat value, Class 3 = low habitat value and Class 4 = very low to nil habitat value. Change in habitat for key indicator species is presented and discussed in terms of changes in areas (ha) of high, moderate, low and very low to nil suitability habitat. In addition, change in habitat (ha) was assessed using habitat associations for other species of management concern.

The assessment methods accounted for the ability of reclaimed lands to provide suitable habitat for key wildlife indicators (see Volume 3A, Section 11.4.1.1). The assessment quantifies the change in habitat suitability for each key indicator, based on vegetation changes resulting from disturbance and the subsequent change after reclamation.

As stated in response to AEP Question 99, there is greater likelihood of success with reclamation, compared to restoration. Reclaimed areas will be seeded with a native seed mix and will be supported by natural recovery of trees and shrubs. Reclaimed areas will provide suitable habitat for a variety of wildlife species. Alberta Transportation will work with Indigenous groups and regulators to determine appropriate final seed mixes.

The assessment methods and conclusions take into account both quantitative changes in habitat suitability classes for various species and the expected reclamation outcomes. As a result, they do not underestimate the Project residual effects on change in habitat.

Question 109

Supplemental Information Request 1, Question 434, Page 6.192

The response provided does not comply with the *Wildlife Act* and Regulation, which protects some of the habitat features identified. Preconstruction surveys will be critical to preventing destruction or disturbance of these protected species and habitat features.

a. Explain how Alberta Transportation will comply with the *Wildlife Act* and Regulation.

Response

a. Alberta Transportation will comply with the Alberta *Wildlife Act* and Regulation by conducting pre-construction surveys to identify wildlife features that are protected under the *Wildlife Act* (e.g., nests, dens) and develop appropriate site-specific mitigation to reduce any potential Project effects as described in the EIA, Volume 3A, Section 11 and in the draft WMMP.

Question 110

Supplemental Information Request 1, Question 435, Page 6.193

Frequent grizzly bear use has been confirmed along the Elbow River and surrounding habitat within the PDA, LAA, and RAA. This is important habitat for many species consistent with the associated KWBZ. The original SIR has not been answered and the methods used in the assessment as referenced in the response are also limited.

a. Why were impacts to movement and risk not further assessed or discussed?

b. Explain the rationale for adequacy of the assessment methods on grizzly movements along the Elbow River valley.

c. Does Alberta Transportation have confidence in their ability to understand impacts of the project on grizzly use and movement along the Elbow River? Explain.

Response

a-b. The potential effects of the Project on grizzly bear movement and mortality risk was assessed using the best available information. Alberta Transportation's response to Round 1 AEP IR435 indicated that the EIA, Volume 3A, Section 11.4.3.3, page 11.60 discusses potential Project effects on grizzly bear movement. Volume 3A, Section 11.2.2.5, page 11.38 also discusses grizzly bear movement based on radio-telemetry data provided by Stenhouse (2016, pers. comm) and Paczkowski (2016, pers comm.), which indicated grizzly bear movement through the LAA and RAA.

The potential effects on grizzly bear mortality risk are discussed in Volume 3A, Section 11.4.4. During construction, there is potential for increased mortality risk due to human-wildlife conflicts (e.g., bears). During dry operations, the reduction of on-site activity is expected to reduce the risk to grizzly bears compared to the construction phase. The mitigation described in Volume 3A, Section 11.4.4.2, is designed to manage human-wildlife conflict and reduce potential mortality risk on grizzly bear (e.g., waste will be stored in wildlife-proof containers and wildlife awareness will be provided to staff on-site).

The assessment includes information that was publicly available prior to the time of the EIA submission. Potential Project effects on grizzly bear movement are assessed qualitatively largely because there are no detailed studies available that identify grizzly bear-specific movement routes in the Project area, other than the radio-collared grizzly bear that was observed to travel through the LAA and RAA as well as the grizzly bears that were detected along Elbow River during the baseline remote camera survey (see Volume 4, Appendix H, Section 3.6 of the EIA).

c. The conclusions stated in the wildlife assessment related to potential Project effects on grizzly bear habitat, movement and mortality risk are robust, based on the assessment methods used and the information available at the time of preparation. The assessment recognized that there is some uncertainty related to wildlife movement and how various species (including grizzly bear) might respond to the diversion channel, floodplain berm and off-stream dam during dry operations (see Volume 3A, Section 11.6). The final WMMP (i.e., remote camera study) will help to better understand potential Project effects on grizzly bear use and movement along Elbow River, including assessment predictions and the effectiveness of mitigation measures.

REFERENCES

Paczkowski, J. 2016. Wildlife Biologist, Alberta Parks. Personal communication, email.

Stenhouse, G. 2016. Wildlife Carnivore Biologist, Foothills Research Institute. Personal communication, email.

6 HEALTH

Question 111

Supplemental Information Request 1, Question 206, Page 4.4
Supplemental Information Request 1, Figure IR206-1, Page 4.4
Supplemental Information Request 1, Question 444, Pages 7.26-7.37
Supplemental Information Request 1, Figure IR444-2, Page 7.29
Supplemental Information Request 1, Figure IR444-3, Page 7.30
Volume 3A, Section 15.4.1, Tables 15-12, 15-13, 15-14, Pages 15-45 to 15-53

Alberta Transport states *During construction, activities between the diversion channel and the dam, there will be 24-hour continuous wind and air quality monitoring for $PM_{2.5}$ and TSP at Stations 1 and 2 along the haul road and at Station 3 near the borrow source area as illustrated on Figure IR206-1. The proposed locations of the air quality monitoring stations were selected based on modelling results.*

The results of the HHRA indicate the predicted air concentration exceeds the acceptable criteria at SR41 and SR19. Both locations are representative of permanent residences and close to other residences. The proposed monitoring stations are not in the vicinity of these locations.

a. Describe a monitoring program inclusive of the SR41 and SR19 locations.

Response

a. The proposed monitoring program has been adjusted to provide monitoring data representative of the SR41 and SR19 locations. The proposed monitoring program is explained in detail below.

   Three ambient air quality monitoring stations are proposed outside the PDA, as described in Alberta Transportation's response to Round 1 AEP IR206 and shown in Figure IR206-1. The ambient air monitoring will include monitoring of $PM_{2.5}$ and TSP. The locations of the air quality monitoring stations are based on the highest expected fugitive dust emissions generated by the haul trucks transporting earth material from the diversion channel to the dam, and the spatial distribution of maximum predicted $PM_{2.5}$ and TSP concentrations.

   Two monitoring locations (Station 1 and Station 2) are proposed between the haul road from the diversion channel excavation work to the dam construction site and nearby residences, and one monitoring location (Station 3) is proposed between the borrow source area and nearby residences (see Alberta Transportation's response to Round 1 AEP IR206, Figure IR206-1).

The EIA, Volume 3A, Section 15, Table 15-13 indicates that the ERs for the predicted 24-hour $PM_{2.5}$ concentrations are greater than 1.0 at two human receptors (SR19 and SR41) for the Project Case. The highest ERs for 24-hour $PM_{2.5}$ concentrations are at human receptors SR19 and SR41 for both the Project Case and Application Case.

Receptors SR19 and SR41 are close together and, as a result, it is proposed that a single monitoring station will be sufficient to provide monitoring results representative of both locations. To provide additional monitoring results representative of residences, the preliminary recommended monitoring location for Station 1 is closer to human receptors SR19 and SR41, as shown in Figure 111-1. The exact locations of the monitoring stations will be determined during the development of the Environmental Construction Operations Plan (ECO Plan) by the construction contractor, regulatory guidance, and practical siting constraints such as land availability, site access, safety, availability of electrical power, and siting recommendations within the AEP Air Monitoring Directive. The ECO Plan will follow the requirements outlined in Alberta Transportation's ECO Plan framework (Volume 4, Supporting Documentation, Document 4) and Alberta Transportation's Civil Works Master Specifications for Construction of Provincial Water Management Projects (Volume 4, Supporting Documentation, Document 10) and any air monitoring conditions of Project approval required by regulatory agencies.

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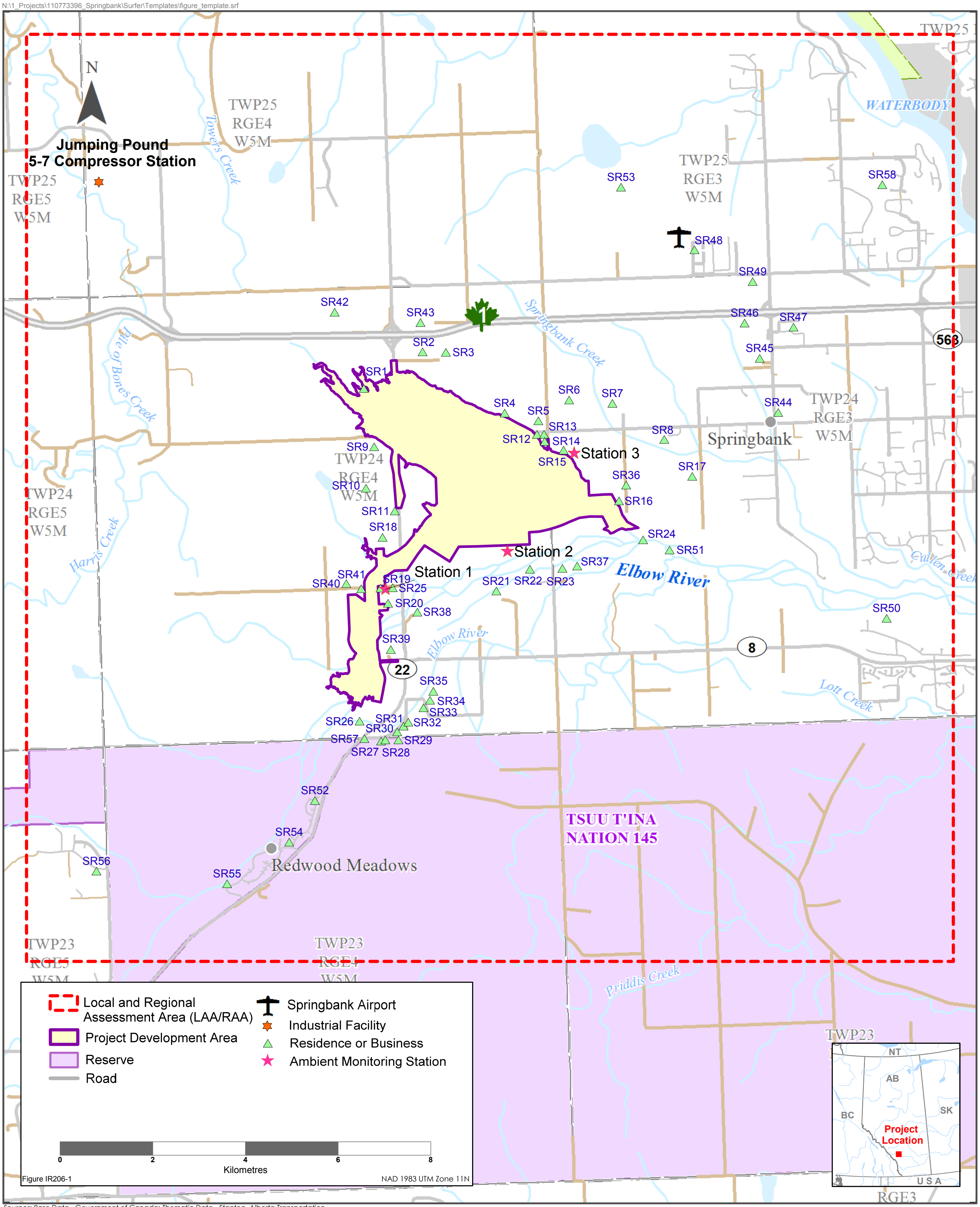

Sources: Base Data - Government of Canada; Thematic Data - Stantec, Alberta Transportation

Updated Preliminary Locations of Ambient Monitoring Stations during Construction

Stantec

SPRINGBANK OFF-STREAM RESERVOIR PROJECT

Figure 111-1

Question 112

Supplemental Information Request 1, Question 448, Page 7.44
Volume 3A, Section 15.4.1.4, Page 15.39
Volume 3B, Section 15.4.1.4, Page 15.18
Volume 4, Appendix O

The conclusions of the HHRA are dependent on the predicted air dispersion modelling results. Through the SIR process, additional air modelling may be required for the air quality portions of the application thus generating new predicted air concentration data.

a. In the event that new or additional air dispersion data is generated for selected Chemicals of Potential Concern (COPC), compare the results to health-based Toxicological Reference Values (TRVs) and discuss the potential health impact or provide justification for not completing these steps.

Response

a. As of the date of this filing, no new or additional air dispersion modelling has been required or undertaken since the filing of the EIA.

7 ERRATA

Question 113

Supplemental Information Request 1, Question 206, Table IR206-1, Page 4.4

Alberta Transportation states the 24-hour Alberta Ambient Air Quality Objective (AEP 2019) for Fine Particulate Matter ($PM_{2.5}$) as 30 µg/m^3 in Table IR206-1. This is incorrect. The 24-hour AAAQO for Fine Particulate Matter ($PM_{2.5}$) is 29 µg/m^3.

a. Correct Table IR206-1 so that the correct value is referenced.

Response

a. The response to Round 1 AEP IR206, Table IR206-1 is revised below in Table 113-1 (see **red** text) to indicate the revised Alberta's Ambient Air Quality Objectives (AAAQO) (AEP 2019).

Table 113-1 Air Quality Objectives During Construction, $PM_{2.5}$ and TSP (revision to Table IR206-1)

Substance	Averaging Period	Measurement
Fine Particulate Matter – 2.5 microns or less ($PM_{2.5}$)	24-hour	**29 µg/m^3**
Total Suspended Particulate Matter (TSP)	24-hour	100 µg/m^3

REFERENCES

AEP (Alberta Environment and Parks). 2019. Alberta Ambient Air Quality Objectives and Guidelines Summary. January 2019. Alberta Environment and Parks (AEP). Available at: https://open.alberta.ca/dataset/0d2ad470-117e-410f-ba4f-aa352cb02d4d/resource/4ddd8097-6787-43f3-bb4a-908e20f5e8f1/download/aaqo-summary-jan2019.pdf. Accessed: January 2020.

APPENDIX 87-1 DRAFT GUIDING PRINCIPLES AND DIRECTION FOR FUTURE LAND USE

ALBERTA TRANSPORTATION SPRINGBANK OFF-STREAM RESERVOIR PROJECT
RESPONSE TO NRCB AND AEP SUPPLEMENTAL INFORMATION REQUEST 2,
DATED NOVEMBER 18, 2019

Stantec

DRAFT GUIDING PRINCIPLES AND DIRECTION FOR FUTURE LAND USE

PROPOSED SPRINGBANK OFF-STREAM RESERVOIR PROJECT

Introduction

The Elbow River flood of 2013 was a devastating event both socially and economically for many Albertans. The flood tragically resulted in 5 deaths and forced the evacuation of over 80,000 people (one of the largest evacuations in Canadian history). A study completed by IBI Group estimated that should a 2013 level flood event on the Elbow River occur again without adequate protection, up to $1.5 billion of property and infrastructure damage is at risk which could result in permanent damage to the economic future of the region.

For reference, the 2013 flood was the most significant flood of record in Alberta on the Elbow River and had an estimated peak flow of 1,240 cubic meters per second (m^3/s). Statistically, the 2013 flood has been estimated to be slightly greater than a 1:200-year flood. To put it another way, there is 0.5% chance of a similar flood occurring each year on the Elbow River.

Following the flood of 2013, the Government of Alberta undertook an assessment of mitigation strategies that could be used to reduce the risk of future floods. Communities in Calgary along the Bow and Elbow rivers were among the most heavily impacted. The proposed Springbank Off-Stream Reservoir (SR1 or the Project) was identified as the preferred option to mitigate flooding upstream of Calgary along the Elbow River.

The construction and management of a dry reservoir presents a unique opportunity with the conversion of private land to Crown land. If the proposed Project is approved, upon commissioning of the Springbank dam and diversion, Alberta Environment and Parks (AEP) will be responsible for land management and operation of the project infrastructure, and management of the associated Crown land for the reservoir.

This land is currently not accessible to the public without permission from the landowners. The future uses of the Land Use Area (LUA) will be determined, after engagement with First Nations and stakeholders regarding such future uses, in accordance with any applicable Government of Alberta policies and procedures at the time of engagement. This document provides direction around government intentions related to future land use, and the process for setting the management intent for these lands, if the project proceeds.

Alberta Transportation (AT) is seeking regulatory approval of SR1 which also includes securing any required private lands to be converted to Crown lands. AT is undertaking initial First Nations and stakeholder discussion around desired future land use and access. This document is intended to support AT's engagement during the regulatory process of SR1 and provide high level direction and certainty for land use by future users. Detailed land use planning will be undertaken following regulatory decisions on the Project. This detailed planning will be informed by the information gathered during the engagement conducted during the regulatory process, as well as by future engagement processes with First Nations and stakeholders.

Guiding Principles for Future Land Use

1. The primary and overarching use of the Crown land within the reservoir footprint is for flood mitigation. No activities may limit or otherwise hinder the ability of the reservoir to fill to full supply level for the purpose of flood mitigation or water management within the watershed.
2. The reservoir may fill at any point in the year without warning, including during periods below peak floods and may be inaccessible for an undetermined amount of time, post drawdown, due to silt and debris buildup or other unintended consequences requiring remediation.
3. Compensation will not be provided by the Crown for any impacts to land use activities resulting from operation of the Project infrastructure.
4. Safety is paramount in any decisions that allow for access onto the reservoir lands. Restrictions on some or all land uses will be issued during specified periods of the year as required to reduce risks to safety and property from flooding.
5. There will be no access permitted on or across the Project infrastructure at any time or for any purpose (see attached map and refer to dark pink areas). The Project infrastructure will include the intake structure on the Elbow River and main diversion canal, main dam, emergency spillway and outlet canal to the Elbow River in its entirety.
6. Use of the lands by First Nations may be considered a priority outside of flood and remediation periods in order to enable treaty rights and traditional uses.
7. Non-motorized recreational access may be considered, in accordance with approved land uses.
8. Access for specific purposes such as grazing may be considered and used as a tool to manage and maintain the grassland landscape in the SR1 area consistent with operational plans set by AEP.
9. All land use decision making will remain under the authority of AEP.
10. No non-flood related permanent or temporary infrastructure will be permitted in the reservoir or setback area.

Direction for Future Land Use Planning

The future uses of the LUA will be determined after engagement with First Nations and stakeholders regarding such future uses, in accordance with any applicable Government of Alberta policies and procedures at the time of engagement.

Land-use planning decisions will be implemented using the appropriate land-management tools available to the Government of Alberta, in accordance with legislation applicable at the relevant time.

The purpose of conducting engagement is to inform and gather input to be incorporated in the development of a future land use plan for the LUA. Through a series of engagement activities with First Nations and stakeholders, Government staff will gather information and analyze feedback to develop direction for future land use, having regard to the Government's need for flood mitigation and the information expressed by First Nations and stakeholders. The direction for future land use will be provided to First Nations and stakeholders for comment. It is expected that there will be a separate engagement process for First Nations.

First Nation engagement:

Use of existing forums that involve First Nations in Government planning may be used to initiate discussions. Through the South Saskatchewan Regional Planning process, there is a venue for regular discussions and sharing of information between First Nations and Government. Additional one-on-one meetings will be arranged with interested First Nations to allow for meaningful discussions.

Stakeholder engagement:

Stakeholders will be invited to a series of workshops and meetings to allow for the sharing of perspectives, issues/concerns, and desired use of the LUA. This could include technical workshops, online information, multi-stakeholder meetings and/or sector based meetings.

1. Primary Use - Flood mitigation and water management

Outcome: The land use is managed for the primary purpose of providing storage for flood mitigation to communities and infrastructure downstream of SR1.

Strategies:

1.1. SR1 will be used to divert and store water from the Elbow River for the purpose of flood mitigation and water management.
1.2. The timing and volume of water both stored and released from the SR1 reservoir will be coordinated with the larger water management system in the watershed.
1.3. AEP will be responsible for ongoing operation, management and maintenance of the reservoir footprint and flood management infrastructure.
1.4. AEP will engage with First Nations, stakeholders, municipalities and, local landowners as per the facilities engagement/communication plan.

2. Secondary Uses

In light of the Primary Use, the safety of anyone with access or land users will be an overriding factor.

A. First Nation Use

Outcome: Traditional First Nation access and use of land will be informed by the "Guiding Principles" outlined in this document.

Strategies:

2.1. The Government of Alberta commits to engaging with First Nations in the process to finalize the land use plan for the LUA.
2.2. In general, First Nations' traditional activities, including the exercise of treaty rights such as hunting, will be allowed.

2.3. The Government of Alberta will utilize regulations and policies enabling hunting access and staging areas.

B. Other activities

Outcome: Other activities will be considered where they align and are compatible with the overarching management intent of flood mitigation as per the Guiding Principles outlined in this document.

Strategies:

2.4. Vegetation and habitat management as well as any post-flood remediation actions will be in compliance and consistent with the regulatory approvals for the Project. Opportunities for Indigenous participation in these aspects are addressed in the project's Indigenous Participation Plan.
2.5. In general, only uses and activities that have a minimal impact on the land will be allowed. Therefore, the availability of surface dispositions will be limited.
2.6. Grazing permits may be issued for pasture land within designated zones, and at certain times, where determined by AEP as the appropriate tool to manage grasslands for ecosystem health or wildfire mitigation.
2.7. Non-motorized recreational access may be considered (e.g. hiking, biking, cross country skiing).

Land Use Planning Process

During the Project application period, Alberta Transportation will continue to explore opportunities and desired uses of the lands should the lands be acquired by the Crown and SR1 be approved. This will include meetings with First Nations, stakeholders and local landowners during the engagement process to discuss desired uses. Should the Project be approved, meeting results and desired direction determined during the approval period will be provided to AEP for incorporation or consideration into the land use planning process. AEP will initiate detailed land use planning if the Project receives all necessary provincial and federal approvals.

The land use plan will focus on how the Project lands are used and managed and will not include the operations of the SR1 infrastructure or water management planning in the watershed beyond the reservoir footprint. AEP will be the final decision maker in the land use planning process and management of all Crown lands associated with the Project. AEP is accountable to ensure objectives and outcomes of the Project are met.